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THE COMPOSITION, SOLUBILITY, AND OXIDATION OF LUMBANG OIL

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THREE PLATES

INTRODUCTION

Lumbang oil is obtained from the nuts of *Aleurites moluccana*, which is a large tree reaching a diameter of 80 to 160 centimeters. The genus *Aleurites* contains a number of species which yield nuts having a valuable oil. Perhaps the best known of these oils is Chinese wood oil (tung oil). This is derived from at least two Chinese species of the genus, *Aleurites fordii* Hemsley and *Aleurites montana* Wilson, which do not occur in the Philippines. Tung oil, which has properties quite similar to those of Philippine lumbang oil, has been investigated extensively. It is used in large quantities for the preparation of paints, varnishes, linoleum, and for other similar purposes. In the Philippines, oil is obtained from the nuts of two species of the genus *Aleurites*. Oil from *Aleurites moluccana* is known as lumbang oil, while that obtained from *Aleurites trisperma* is called baguilumbang. The oil now obtained in the Philippines from the genus *Aleurites* is almost entirely the product of *Aleurites moluccana* which is fairly abundant in a wild state in many parts of the Philippines and is also planted. *Aleurites trisperma* is reported from many localities but is probably not so abundant. Both species can be grown readily in plantations.

The Philippine Bureau of Forestry is using large numbers of both species in its reforestation projects and is also distributing seed and encouraging the people to plant these species. During 1918, there were exported 184,428 kilograms of lumbang oil from *Aleurites moluccana,* valued at 129,838 pesos. One American concern, which has experimented with lumbang oil, inquired as to the possibility of obtaining 4,000 tons per month. This fact would seem to indicate that there is a good market for considerable quantities of this oil.

The species *Aleurites moluccana* is also distributed through Polynesia, the Malayan region, and the Hawaiian Islands. In Hawaii the oil from *Aleurites moluccana* is called kukui, or candlenut oil. The latter name is also used in other parts of the world. According to Wilcox and Thompson [1] the Hawaiians strung the nuts on sticks and used them for lighting their houses. This use of the kernels gave rise to the name "candlenut."

Lumbang oil is used for various purposes such as the preparation of paints, varnishes, and linoleum, and for illumination, wood preservation, etc. It has been manufactured in the Philippines in very primitive mills for years and is used locally for illumination, mixing paints, and for protecting bottoms of dugout canoes and other small craft against water and against marine borers.

The oil manufactured locally is made in a few Chinese shops in Manila, with primitive hand apparatus. The nuts are hot-pressed to save labor, but it is said that cold-pressing produces a better grade of oil.

Lumbang oil has a light yellow color and an agreeable odor and taste. It is a drying oil and dries in thin films when allowed to stand. In this respect it resembles linseed oil and also Chinese wood oil (tung oil). Lumbang and linseed oils differ, however, from tung oil when heated. Tung oil heated to a temperature of about 200° solidifies and in this condition is unsuitable for making varnishes. Lumbang and linseed oils do not behave in this manner when heated. Oil from *Aleurites moluccana* (lumbang) or *Aleurites trisperma* (baguilumbang) when heated to a temperature of about 315° and allowed to cool does not gelatinize. When heated continually these oils begin to distill regularly at about 315° and do not gelatinize until about one-third has been volatilized.[2] In so far as this property is con-

[1] Wilcox, E. V., and Thompson, A. R., Press Bull. Hawaii Agr. Exp. Station 39 (1913).

[2] West, A. P., and Brown, W. H., Bull. P. I., Bur. Forestry 20 (1920) 121.

cerned the Philippine lumbang oils are more suitable for varnish making than is tung oil.

Several investigations [3] of lumbang oil have been made and a review of the literature is given by West and Brown.[4]

Investigations have shown that lumbang nuts are composed of about 66 per cent of shells and 34 per cent of kernels. Analysis of the kernels shows that the principal constituents are oil (consisting largely of fat) and protein. The percentage of fiber and ash is very low. The kernels when eaten are strongly purgative and produce also a very nauseating effect. They yield about 50 to 60 per cent of oil. The constants and general properties of lumbang oil are very similar to those of tung and of linseed oil. These three oils are drying oils and are characterized by high iodine and saponification values. Analysis of lumbang-oil cake, obtained by expelling the oil from the crushed kernels, shows that it is valuable as fertilizer, but it cannot be used as cattle food because it has a poisonous effect upon stock.

The object of the present investigation was to ascertain the composition of lumbang oil and to study some of its properties.

SAMPLE

The nuts of *Aleurites moluccana* have very hard shells which are difficult to crack; and, moreover, it is not easy to separate the kernel from the shell. Various practical methods have been used for preparing the oil from the nuts. The sample of lumbang oil used in this investigation was obtained from Mr. R. H. Aguilar, of the Bureau of Science, who used his own method [5] to extract the oil from the nuts. The nuts were heated in an oven at 95° C. from three to four hours, thrown quickly into cold water, and allowed to remain overnight. The next morning the shells had burst and the kernels were easily separated. The kernels were then ground into a meal, placed in a small press, and the oil separated from the oil cake, after which the oil was filtered. The oil was preserved in a large glass-stoppered bottle which was paraffined and kept in a dark closet. Owing to pressure of other duties we were not able to begin our work until

[3] Richmond, G. F., and Rosario, M. V. del, Philip. Journ. Sci. § A 2 (1907) 439; Wilcox, E. V., and Thompson, A. R., Press Bull. Hawaii Agr. Exp. Station 39 (1913); Brill, H. C., and Agcaoili, F., Philip. Journ. Sci. § A 10 (1915) 111; Aguilar, R. H., Philip. Journ. Sci. § A 12 (1917) 235 and 14 (1919) 275.

[4] West, A. P., and Brown, W. H., op. cit., 122.

[5] Aguilar, R. H., Philip. Journ. Sci. 14 (1919) 279.

about eight months after the sample had been prepared. The results obtained in this investigation really represent the condition of the oil after storing.

The sample of lumbang oil used in this investigation had a saponification value of 214, and an iodine value (Hübl) of 140. Both the saponification and the iodine values were determined according to the method of Lewkowitsch.[6]

The specific gravity of the oil $^{31}_{4}$°C. was 0.9206.

COMPOSITION

Lumbang oil is a quick-drying oil and resembles linseed oil and Chinese wood oil (tung oil) in its general properties. These three oils have somewhat similar constants and are characterized by high iodine and saponification values. Although the exact composition of both tung and linseed oils is still somewhat uncertain, it is generally believed that tung oil consists chiefly of the glycerides of oleic and elaeomargaric acids, while linseed oil contains linolenic, linolic, a small percentage of solid acids, and possibly oleic acid. The composition of tung oil is therefore quite different from that of linseed oil. Since both tung and lumbang oils are obtained from the same genus, *Aleurites*, we were inclined to think that probably lumbang oil had a composition more like that of tung than linseed oil and, like tung oil, contained elaeomargaric acid. We therefore tested our sample of lumbang oil for the presence of elaeomargaric acid. In making this test we used the method of Schumann [7] which depends upon the fact that elaeomargaric acid has the property of crystallizing in rhombic flakes from dilute alcohol solution at 0°. We did not obtain any crystals and examination of the solution under the microscope showed the entire absence of crystals.

Tung oil when tested by the bromo-derivative method of Eibner and Muggenthaler [8] gives no crystalline precipitate of ether-insoluble brominated glycerides, whereas linseed oil gives a copious precipitate amounting to about 38 per cent. This test is regarded as an important test for the purity of linseed oil. We tested our sample of lumbang oil by the bromo-derivative method and found that, like linseed oil, it also yields a large crystalline

[6] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1913) 380 and 397.

[7] Schumann, C. L., Journ. Ind. Eng. Chem. 8 (1916) 9.

[8] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1913) 568–578.

precipitate of brominated glycerides. Since lumbang oil contains no glyceride of elaeomargaric acid and yields bromo derivatives we concluded that lumbang oil has a composition quite different from that of tung oil and probably shows a closer resemblance to linseed oil. Accordingly we decided to investigate the composition of lumbang oil by means of the lead-salt-ether method of Gusserow and Varrentrapp [9] and the bromo-derivative method of Eibner and Muggenthaler.[9]

The lead-salt-ether method is used to separate the saturated from the unsaturated (liquid) acids in an oil and the bromo-derivative method is used to separate the various unsaturated acids from each other. Recently these methods have apparently been used very successfully by Baughman and Jamieson in their investigations on hubbard squash seed [10] oil and also on okra,[11] cottonseed,[12] and cantaloup seed [13] oils.

These investigators do not state, however, the exact experimental procedure they used in carrying out these methods. Lewkowitsch points out that the results obtained by the lead-salt-ether method vary with the experimental procedure and the accuracy depends principally upon the temperature and quantity of ether used.

In endeavoring to separate the saturated from the unsaturated acids in lumbang oil we carried out a number of experiments by means of the lead-salt-ether method. Although our results at first were not very uniform, we found that by adopting a standard method of procedure we could obtain fairly uniform results. Our method for preparing the lead salts of the saturated and unsaturated acids and for separating the lead salts of the saturated from those of the unsaturated acids was practically the same as that given by Lewkowitsch and also by Villavecchia.[14] Our subsequent procedure for preparing the saturated and unsaturated acids from their lead salts was, however, somewhat different.

In using the lead-salt-ether method we proceeded in the following manner: About 9 grams of lumbang oil were saponified

[9] Lewkowitsch, J., op. cit. 545, 568–578.

[10] Baughman, W. F., and Jamieson, G. S., Journ. Am. Chem. Soc. 42 (1920) 152.

[11] Ibid. (1920) 166.

[12] Ibid. (1920) 1197.

[13] Ibid. (1920) 2398.

[14] Villavecchia, V., Treatise on Applied Analytical Chemistry 1 (1918) 384.

in a liter flask by heating (reflux) for two hours with 100 cubic centimeters of half normal alcoholic potassium hydroxide. The alcohol used in preparing the potassium hydroxide solution was previously purified by Dunlap's method,[15] which consists in treating the alcohol with silver nitrate and potassium hydroxide, heating (reflux), and distilling. The reaction product obtained by saponifying lumbang oil was treated with a few drops of alcoholic phenolphthalein solution and acidified with glacial acetic acid, after which it was neutralized with half normal alcoholic potassium hydroxide solution. The bulk of the alcohol was then eliminated by distillation. Sixty cubic centimeters of 10 per cent lead acetate solution were diluted with 300 cubic centimeters of distilled water, brought to boiling, and gradually added with frequent shaking to the residue in the flask. The flask was then filled completely with hot distilled water, and allowed to cool. Upon cooling, the solution in the flask became clear and the lead soap adhered to the flask. The clear solution was then decanted to a filter paper, and the lead soap in the flask was washed four or five times with hot water until no more traces of lead acetate could be detected in the washings. Each time the lead soap was washed the solution was cooled before decanting.

To the lead soap in the flask, 300 cubic centimeters of ether previously purified were added and the resulting ethereal mixture was heated (reflux) on a water bath with frequent shaking for about half an hour until most of the lead soap was apparently dissolved. The ethereal solution was then allowed to stand for twenty-four hours, after which it was filtered through a plaited filter kept covered with a watch glass. The residue on the filter paper containing the lead salts of the solid saturated acids was washed thoroughly with ether. The ethereal filtrate containing the lead salts of the liquid unsaturated acids was placed in a flask, stoppered securely, and set aside in a dark closet until the work on the lead salts of the solid acids was completed.

SOLID ACIDS

The precipitate of the lead salts of the solid fatty acids together with the filter paper was placed in a flask and boiled about an hour with 200 cubic centimeters of dilute hydrochloric acid (1:4). The solution was then cooled, and the solid acids resulting from the decomposition of their lead salts were extracted with ether. The ethereal layer after separating from the acid solution was washed with water until free from acid. It was

[15] Dunlap, F. L., Journ. Am. Chem. Soc. 28 (1906) 397.

then dehydrated with anhydrous sodium sulphate, filtered, and the ether distilled off in a weighed flask.

The solid acids melted at 54° and had an iodine value (Hübl) of 18.05. We did not have enough material to determine accurately the neutralization value and consequently did not calculate the mean molecular weight. We also did not endeavor to separate and identify the solid acids by converting them into their methyl esters and distilling fractionally.[16]

LIQUID ACIDS

The ethereal solution containing the lead salts of the liquid unsaturated acids was shaken with dilute hydrochloric acid (1 : 4) and the lower acid layer with the precipitated lead chloride separated. The treatment with hydrochloric acid was repeated and the separated ethereal solution washed thoroughly with distilled water until the wash solution was no longer acidic, after which it was filtered through a plaited filter kept covered with a watch glass. The solution, which was somewhat turbid due to the presence of moisture, was then dehydrated with a considerable quantity of anhydrous sodium sulphate. When working on rainy days a second dehydration with sodium sulphate is usually necessary to render the solution absolutely clear. The solution was then filtered and the clear filtrate distilled in a 500-cubic centimeter Florence flask to eliminate most of the ether. When the volume of the solution was reduced to about 100 cubic centimeters it was transferred to a 200-cubic-centimeter, flat-bottomed distilling flask previously weighed, and the ether completely distilled off.

The liquid acids had an iodine value (Hübl) of 135.8. The neutralization value was 191.9, and the calculated mean molecular weight, 292.5.

The figures given in Table 1 show the results we obtained by the lead-salt-ether method.

TABLE 1.—*Separation of the solid acids from the liquid unsaturated acids in lumbang oil by the lead-salt-ether method.*

Experiment.	Oil used.	Liquid acids.	Solid acids.	Liquid acids.	Solid acids.
	Grams.	*Grams.*	*Grams.*	*Per cent.*	*Per cent.*
1	9.6670	9.0644	0.2588	93.77	2.68
2	10.3420	9.5474	0.2870	92.32	2.77
Mean				93.04	2.73

[16] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1913) 555 and 665.

As shown by the figures in Table 1, lumbang oil contains 93.04 per cent of liquid unsaturated acids and 2.73 per cent of solid acids. These figures are the average of the results obtained from two closely agreeing duplicate analyses.

The liquid unsaturated acids were separated and estimated by the bromo-derivative method of Eibner and Muggenthaler,[17] which is based upon the different solubilities of the bromine derivatives of the liquid acids. We followed, in general, the directions given by Lewkowitsch, performing duplicate experiments. About 4 grams of the liquid acids were dissolved in 40 cubic centimeters of dried purified ether. The ethereal solution was then cooled, treated with bromine, and allowed to stand about three hours at −10°. The solution contained a crystalline precipitate (ether-insoluble bromide), showing the probable presence of linolenic acid, since linolenic hexabromide is insoluble in ether. The solution containing the precipitated bromide was then filtered through a weighed filter paper which had been previously dried and kept in a desiccator. The filtrate from the insoluble bromide was set aside and investigated after the work on the insoluble bromide was completed. The insoluble bromide was dried at 50° and weighed. When treated with benzene the insoluble bromide dissolved completely, showing the absence of any octobromides, since the octobromides likely to be present are insoluble in benzene. The crystals obtained by evaporating the benzene solution gave the figures which are compared with the corresponding data for linolenic hexabromide in Table 2.

TABLE 2.—*Compound from lumbang oil and linolenic hexabromide.*

Compound.	Melting point.	Bromine content.
	°C.	*Per cent.*
Compound from lumbang oil	178.5	63.59
Linolenic hexabromide	180.0	63.32

The bromine content was determined by boiling about 0.1 gram of the crystals with about 0.5 gram of solid silver nitrate and 30 cubic centimeters of pure concentrated nitric acid. The precipitated silver bromide was collected on a Gooch funnel.

The figures given above show that these crystals were linolenic hexabromide and that lumbang oil contains linolenic acid as linolenic glyceride.

[17] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1913) 568 to 578.

The filtrate from the ether-insoluble bromide (linolenic hexabromide) was shaken in a separating funnel with 10 per cent sodium thiosulphate solution to remove the excess of bromine. This treatment was repeated to remove the last traces of bromine, after which the separated ethereal solution was dehydrated with anhydrous sodium sulphate, filtered, and distilled to eliminate the ether. The slightly yellow-colored residue which remained was then treated with 1.5 liters of purified petroleum ether (boiling point 35° to 55°) and the mixture heated (reflux) until nearly all the crystals were dissolved. The solution was then cooled and filtered through a weighed filter paper. By concentrating the petroleum ether filtrate to a volume of about 300 cubic centimeters and allowing the solution to stand overnight, a second crop of crystals was obtained. Repeated experiments showed that the second crop of crystals always gave a sharper melting point than the first crop and the bromine content was considerably nearer the theoretical value for linolic tetrabromide. As oleic dibromide is very soluble in petroleum ether while linolic tetrabromide is difficultly soluble, the crystals thus obtained were probably linolic tetrabromide while the filtrate from these crystals contained, possibly, a mixture of linolic tetrabromide and oleic dibromide. The crystals that we suspected to be linolic tetrabromide gave figures which are compared to the corresponding data for linolic tetrabromide in Table 3.

TABLE 3.—*Compound from lumbang oil and linolic tetrabromide.*

Compound.	Melting point.	Bromine content.
	°C.	*Per cent.*
Compound from lumbang oil	112 to 113	53.10
Linolic tetrabromide	113	53.33

The bromine content was determined as in the case of linolenic hexabromide. These figures show that these crystals were linolic tetrabromide and that lumbang oil contains linolic acid as linolic glyceride.

The petroleum ether filtrate from the crystalline linolic tetrabromide was concentrated to a volume of about 100 cubic centimeters, transferred to a small distilling flask which had been previously weighed, and the solution distilled until no more petroleum ether passed over. The dark residue thus obtained was then weighed and the bromine content determined. The bromine content of linolic tetrabromide is 53.33 per cent; and of oleic dibromide, 36.18 per cent. Knowing the bromine content of the residue, the percentage of linolic tetrabromide and

of oleic dibromide (if present) is calculated readily. In carrying out these experiments we found that the ordinary commercial petroleum ether did not give very good results; but, by redistilling the commercial product and using only the fraction boiling from 35° to 55°, fairly good results could be obtained. Our residue, however, still had a perceptible odor of petroleum ether, which we were unable to eliminate by distilling. Probably better results could be obtained, if some other solvent suitable for this work could be used in place of petroleum ether.

In investigating the liquid unsaturated acids of lumbang oil by means of the bromo-derivative method we performed duplicate experiments. The results of these experiments are recorded in Tables 4 and 5. In Table 6 is given a summary of the results recorded in Tables 4 and 5.

TABLE 4.—*Analysis of liquid unsaturated acids of lumbang oil (bromo-derivative method). Experiment I.*

	Grams.
Sample of liquid acids	2.8400
Hexabromide (ether-insoluble bromide); melting point, 178.5°; bromine content, 63.59 per cent	0.5502
First crop of tetrabromide; bromine content, 53.92 per cent	0.1308
Second crop of tetrabromide; melting point, 112° to 113°; bromine content, 53.10 per cent	0.6666
Residue (dibromide and tetrabromide); bromine content, 41.80 per cent	3.9546
Dibromide in residue, 67.23 per cent	2.6586
Tetrabromide in residue, 32.77 per cent	1.2960
Total tetrabromide found	2.0934
Linolenic acid equivalent to hexabromide	0.2019
Linolic acid equivalent to tetrabromide	0.9778
Oleic acid equivalent to dibromide	1.6960

TABLE 5.—*Analysis of liquid unsaturated acids of lumbang oil (bromo-derivative method). Experiment II.*

	Grams.
Sample of liquid acids	2.6372
Hexabromide (ether-insoluble bromide); melting point, 178°; bromine content, 63.69 per cent	0.4586
First crop of tetrabromide; bromine content, 53.78 per cent	0.1826
Second crop of tetrabromide; melting point, 112°; bromine content, 53.08 per cent	0.5316
Residue (dibromide and tetrabromide); bromine content, 42.04 per cent	3.6032
Dibromide in residue, 65.83 per cent	2.3722
Tetrabromide in residue, 34.17 per cent	1.2310
Total tetrabromide found	1.9452
Linolenic acid equivalent to hexabromide	0.1684
Linolic acid equivalent to tetrabromide	0.9086
Oleic acid equivalent to dibromide	1.5150

TABLE 6.—*Analysis of liquid unsaturated acids of lumbang oil. Summary of experiments I and II.*

Acid.	Experiment I.	Experiment II.	Mean.
	Per cent.	*Per cent.*	*Per cent.*
Linolenic	7.11	6.39	6.75
Linolic	34.43	34.46	34.44
Oleic	59.78	57.44	58.61
Total	101.32	98.29	99.80

As previously stated, a determination of the iodine value of the mixed liquid acids separated by the lead-salt-ether method gave us a value of 135.8. A mixture of linolenic, linolic, and oleic acids in the proportions given in the table above would have a calculated iodine value of 133.8. The calculated iodine value of the liquid acids therefore agrees fairly well with the observed value.

The mean percentages of linolenic, linolic, and oleic acids in the mixture of unsaturated acids, as given in Table 6, were calculated into percentages of glycerides in the original oil. The results are recorded in Table 7. In calculating these results we used the average data obtained by the lead-salt-ether method, which showed that lumbang oil when decomposed yields 93.04 per cent of liquid unsaturated acids.

TABLE 7.—*Calculation of unsaturated acids to glycerides in lumbang oil.*

Acid.	Mixture of unsaturated acids.	Original oil.	Glycerides in original oil.
	Per cent.	*Per cent.*	*Per cent.*
Linolenic	6.75	6.28	6.56
Linolic	34.44	32.04	33.48
Oleic	58.61	54.53	56.98
Total	99.80	92.85	97.02

The average results we obtained by the lead-salt-ether method showed that lumbang oil can be decomposed into 93.04 per cent liquid unsaturated acids and 2.73 per cent solid acids. The liquid acids separated by the bromo-derivative method and calculated on the basis of the original oil gave a total percentage of 92.85 (Table 7), which agrees very closely with the figure 93.03 obtained by the lead-salt-ether method.

The percentage of solid acids (2.73) calculated as stearic glyceride gives the figure 2.85, which really represents the percentage of glycerides of the mixed solid acids.

According to our investigation, lumbang oil therefore has the composition shown in Table 8.

TABLE 8.—*Composition of lumbang oil.*

	Per cent.
Linolenic glyceride	6.56
Linolic glyceride	33.48
Oleic glyceride	56.98
Glycerides of solid acids	2.85
Total	99.87

Our experiments show that lumbang oil contains the glycerides of linolenic and linolic acids. Both linolenic and linolic acids and their glycerides absorb oxygen rapidly from the atmosphere. The drying power of oils such as linseed and lumbang is due to the glycerides of linolenic and linolic acids which these oils contain. In general, the more of these compounds an oil contains the quicker it dries. Our results show that lumbang oil has a composition quite similar to that of linseed oil and therefore should be an excellent drying oil.

In addition to ascertaining the composition we determined the solubility of lumbang oil in various solvents and also carried out a series of oxidation experiments.

SOLUBILITY

Lumbang oil at 28° C. is insoluble in cold ethyl and methyl alcohols and acetic acid. It is very soluble in cold turpentine, chloroform, ether, carbon tetrachloride, carbon bisulphide, petroleum ether, and acetone. It is also soluble in ethyl acetate, ethylene bromide, toluene, and nitrobenzene.

OXIDATION

Lumbang oil, like other drying oils, has the characteristic property of absorbing oxygen from the air and drying to an elastic skin when exposed to the air in a thin layer. Brill and Agcaoili [18] investigated the drying properties of lumbang oil by spreading the oil on small glass plates and allowing it to dry (glass-plate method). They found that lumbang oil compares very favorably with tung and linseed oils in the rate of dry-

[18] Brill, H. C., and Agcaoili, F., Philip. Journ. Sci. § A 10 (1915) 119.

ing, quality of film, and the percentage change in weight when drying. They did not, however, determine any of the oil constants during the drying process.

The ability to absorb oxygen may be regarded as an indication of the drying power of an oil. We have carried out experiments on the oxidation of lumbang oil by allowing a slow current of dried air to pass through the oil which was heated to a certain temperature and stirred constantly. The apparatus was arranged in the following manner: A glass salt bottle containing about 400 cubic centimeters of lumbang oil was placed in a water bath which was heated to a temperature of 80°. The glass bottle contained a stopper having three holes. Through one hole passed a stirrer operated by a hot-air motor. The second hole held an entrance tube reaching to the bottom of the bottle and drawn out to a fine opening. The third hole contained a short exit tube also drawn out to a fine opening. A slow current of air was passed through a Drechsel wash bottle containing concentrated sulphuric acid, after which it was passed through three tubes containing soda-lime, and then into the oil. The experiment was started each morning and discontinued at night. At frequent intervals samples of about 15 cubic centimeters were taken and these were later analyzed by determining various constants such as the iodine and saponification numbers. This method of procedure enabled us to follow the changes caused by slow oxidation. The results of these experiments are recorded in Table 9.

TABLE 9.—*Constants of lumbang oil blown at 80° C.*

Time of blowing.	Saponification. No.	Iodine value (Hübl).	Acid No.	Specific gravity $^{31}_{4}$ °C.
Hours.				
0	214.0	140.0	4.962	0.9206
9	229.1	135.3		
15	237.7	126.8		
24	242.6	112.9		
31	252.3	101.0		
47	258.9	81.2		
62	262.6	67.1	7.542	0.9922

As a result of continued oxidation the oil gradually became slightly darker in color and very thick and viscous, and the specific gravity increased considerably. The figures in Table 9

show a gradual increase in the saponification and acid values. This would seem to indicate an increase in the amount of oxidized acids of lower molecular weights. Our results with lumbang are quite similar to those which have been obtained with linseed oil. Since the constants of these two oils are very much alike and they have a similar composition, it is not surprising that they act in a similar manner when oxidized.

The commercial valuation of an oil suitable for the manufacture of varnish depends on its drying power. This is determined by the amount of oxygen it absorbs and also by the time it requires for drying to an elastic skin. It is well known that the oxygen absorption of an oil is closely related to the iodine absorption; in fact, as pointed out by Lewkowitsch,[19] a rough proportionality exists between the quantity of oxygen actually absorbed by an oil and the amount calculated by multiplying the iodine number by 0.063. A determination of the iodine number of an oil which is being oxidized gives us, then, an idea of the amount of oxygen absorbed. The results recorded in Table 9 show a decided, gradual decrease in the iodine numbers, indicating the gradual absorption of oxygen.

When these iodine values are multiplied by the factor 0.063, the resulting figures show the absorbed oxygen calculated from the iodine value, and from these data the average rate per hour of oxygen absorbed in successive intervals can be calculated. Our calculated values showed that the rate of oxidation, under the conditions of our experiment, increased up to a period of thirty-one hours, after which, owing probably to increased viscosity, the rate decreased. Our results would seem to indicate that this oxidation process is an autocatalytic reaction and the oxidation products which are formed in the early stage of the reaction act as autocatalysts and accelerate the reaction. Genthe[20] obtained similar results in his experiments on the drying of linseed oil and was inclined to think that the autocatalyst had the character of a peroxide, though he was not able to isolate such compounds.

The oxidation of lumbang oil for various temperatures and intervals of time is now being investigated, and further discussion of this point will be reserved for a future contribution.

[19] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats and Waxes 1 (1913) 468.

[20] Genthe, A., Zeits. f. angew. Chem. 19 (1906) 2087.

SUMMARY

Lumbang oil apparently has the following composition:

	Per cent.
Linolenic glyceride	6.5
Linolic glyceride	33.4
Oleic glyceride	56.9
Glycerides of solid acids	2.8
Total	99.6

Lumbang oil was found to be soluble in eleven solvents and insoluble in three.

The oxidation of lumbang oil appears to be an autocatalytic reaction.

ILLUSTRATIONS

[Half-tone etchings loaned by the Bureau of Forestry.]

PLATE 1

Aleurites moluccana (lumbang), the source of lumbang oil. Bark, fruits, and leaves.

PLATE 2

Aleurites moluccana (lumbang), the source of lumbang oil. Dried fruits and seeds; natural size.

PLATE 3

Aleurites moluccana (lumbang), the source of lumbang oil. Bark, flowers, and leaves.

PLATE 1. ALEURITES MOLUCCANA (LUMBANG), THE SOURCE OF LUMBANG OIL. BARK, FRUITS, AND LEAVES.

PLATE 2. ALEURITES MOLUCCANA (LUMBANG). THE SOURCE OF LUMBANG OIL. DRIED FRUITS AND SEEDS; NATURAL SIZE.

PLATE 3. ALEURITES MOLUCCANA (LUMBANG), THE SOURCE OF LUMBANG OIL. BARK, FLOWERS, AND LEAVES.

SOME NONDIASPINE COCCIDÆ FROM THE MALAY PENINSULA, WITH DESCRIPTIONS OF APPARENTLY NEW SPECIES[1]

By HAROLD MORRISON

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ONE PLATE AND THIRTEEN TEXT FIGURES

The work reported on in the following pages was begun on the basis of two small collections of coccids sent for possible identification to the Bureau of Entomology by Prof. C. F. Baker in 1918. In the following year, I received from Professor Baker a compiled list of the known Singapore Coccidæ, prepared by himself and Mr. I. H. Burkill. This list included a number of manuscript new species names assigned by Mr. E. E. Green, these giving me my first intimation that Mr. Green was actively engaged in working on Singapore coccids. Following some correspondence regarding the best means of avoiding confusion or duplication, Mr. Green, with his usual generosity, forwarded to me specimens of all of his new nondiaspine species, together with certain notes on the same, and gave me the privilege of describing these new species and of adding them to the work which had been completed on Professor Baker's specimens.

All of the specimens forwarded for description by Mr. Green, and some of those from Professor Baker, were collected by Mr. I. H. Burkill, to whom I am thus indirectly much indebted for the opportunity to examine some very interesting coccids.

Some of the species found in this small collection have presented serious difficulties with respect to proper generic assignment and specific differentiation, and certain of these questions have been settled tentatively only.

All information regarding host, locality, and date of collection was copied from the notes in the packages containing the specimens, and all of the specimens were collected either by Mr. Burkill or by Professor Baker. The drawings illustrating the

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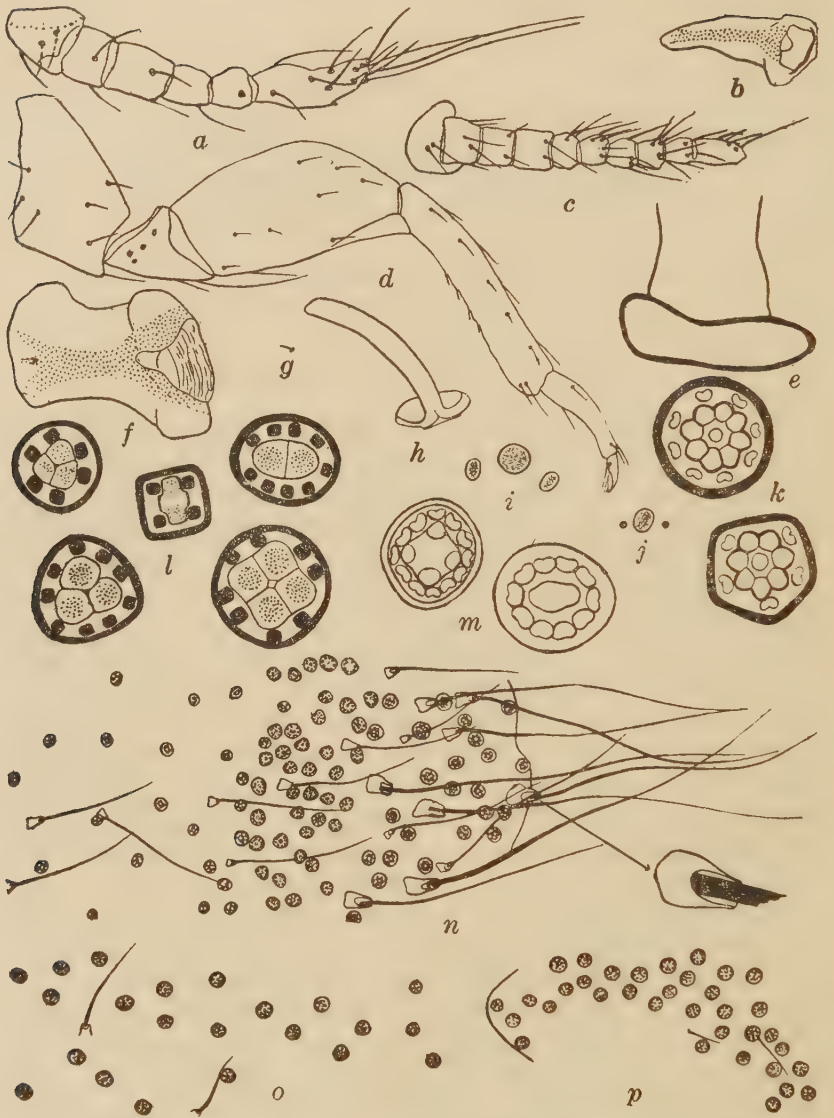

FIG. 1. *Paleococcus pulcher* Leonardi; *a*, intermediate-stage female, antenna, × 115; *b*, intermediate-stage female, thoracic spiracle, × 57.5; *c*, adult female, antenna, × 57.5; *d*, adult female, middle leg, × 57.5; *e*, adult female, anal ring, × 165; *f*, adult female, thoracic spiracle, × 165; *g*, adult female, abdominal spiracle, × 165; *h*, same, × 640; *i*, adult female, ventral abdominal cicatrices, × 57.5; *j*, intermediate-stage female, ventral cicatrices, × 57.5; *k*, adult female, types of dorsal and ventral body pores, × 1,500; *l*, same, types of pores from marginal tufts of body, × 1,500; *m*, same, types of pores from region close to genital opening, × 1,500; *n*, same, a lateral abdominal cluster of pores and setæ, × 220, with detail of base of seta, × 640; *o*, same, portion of ventral abdominal pore band between hind legs, × 220; *p*, same at point where curve around body margin commences, × 220.

structural characteristics of the species have been made by Emily Morrison, who has also been of assistance in other ways; the plate figures showing the superficial appearance of certain of the species have been prepared by Miss Aime Motter.

COCCIDÆ [2]

MONOPHLEBINÆ

Genus PALEOCOCCUS Cockerell

Paleococcus pulcher Leonardi.

Paleococcus pulcher LEONARDI, Ann. R. scuola Sup. Agr. Portici 7 (1907) 1.

Leonardi's placing of this species in the genus *Paleococcus* is followed here without critical consideration.

This species has been identified from a comparison of specimens received from Mr. E. E. Green collected on *Michelia champaca* at the Botanic Gardens, Singapore, April 8, 1916, by Burkill, and on *Rhopaloblasta* palm, Singapore, February, 1917, by Burkill, with a translation of Leonardi's original description. This description, while not so detailed in some respects as is desirable, seems quite sufficient to establish the identity of the Singapore specimens. Mr. Green had tentatively placed these two lots of material under the manuscript names *Icerya ordinata* and *I. palmarum*, respectively, but as careful a comparison of the structural characters of the two lots of specimens as is possible from the limited number of each present fails to disclose any differentiating characters, while the only difference indicated in Mr. Green's notes is in the color of the secretionary covering, the surface coating of that of *ordinata* being lemon yellow, while *palmarum* is supposed to have a pure white coating.

This species is briefly redescribed herewith, with particular emphasis on the structure of the derm pores and the setæ.

Adult female.—Ovate, broadened behind, somewhat convex; maximum length of specimens examined, 6.5 millimeters; width, 4.25; dorsally with a dense coating of white secretion usually strongly tinged superficially with lemon yellow, broken up into distinct plates, these broadly transverse in the center of the dorsum, bordered by a double row of square to oblong plates running clear around the body, with the outer, or marginal, row

[2] The scheme of classification followed is that used by Fernald, M. E., Catalogue of the Coccidae of the World, Bull. Hatch Exp. Sta. Mass. Agr. College 88 (1903).

produced into triangular teeth, giving a serrate appearance; ovisac not developed, the eggs laid beneath the body; maximum length of mounted specimens examined, 6 millimeters; shape when mounted uniformly broad oval; antennæ 9-segmented (normal for genus), sometimes with an indication of a division of the terminal segment; legs normal, rather slender for the group; with two pairs of large thoracic spiracles, and three pairs of very much smaller, simple, abdominal spiracles, the latter placed at the posterior apex of the body; derm pores all multilocular disk, possibly to be considered as of one type, but showing at least three sorts, as shown in figures, one (*k*) grouped along the body margin together with a number of setæ in rather distinct clusters, another (*l*) scattered over the body surface, and the third (*m*) present ventrally around the genital opening; ventrally near the margin with a heavy band of pores running around the abdomen as in typical *Icerya;* derm setæ numerous, varying in size very decidedly, the largest in the tufts along the body margin, all long, slender, rather delicate and hairlike, mostly with long stout sockets, but some with a very short and flat triangular base; anal opening a short, simple tube; with three small ventral cicatrices, the median much the largest.

? Perissopneumon sp.

I desire to place on record here collections of a few specimens of a monophlebine coccid of uncertain affinities in the hope that more material, including larvæ, fully developed adult females, and males, will be discovered by some collector at Singapore, as the correct placing of this species will be almost impossible without such additional material. The collection records are as follows: From rhizomes of *Alpinia conchigera* (*Baker 9020*) and from fruit scales of *Garcinia mangostana* (one specimen) (*Baker 9023*), both from the Botanic Gardens, Singapore, October, 1917. I have had only the brief description of *Perissopneumon ferox* available for consideration in the generic placing of these specimens, but they appear to be more closely related to Newstead's genus than to any other at present known to me.

ORTHEZIINÆ

Genus **ORTHEZIA** Bosc d'Antic

Orthezia insignis Douglas.

This species is represented among Professor Baker's material by a few specimens collected on *Clerodendron penduliflorum*, Botanic Gardens, Singapore, August, 1917 (*Baker 8941*).

DACTYLOPIINÆ

Genus **ANOMALOCOCCUS** Green

Anomalococcus multipori sp. nov. Plate 1, fig. 1.

Adult female.—Occurring on the stems of the host, beneath the cartons or sheds of some species of ant; inclosed in a rather dark brownish or reddish sac, which is irregular in shape, circular to oval, usually broader behind, somewhat convex, typically with rounded, clear, shining, median longitudinal ridge, bordered on each side by a pitted longitudinal groove of varying distinctness, all the surface except the median ridge covered over with white wax, which becomes thick and almost platelike along the margin, while varying in thickness in different spots dorsally; the sack itself homogeneous, tough, but fracturing when torn or broken, translucent, with a nearly circular to slitlike opening dorsally at the posterior end of the median ridge, and the latter sometimes broken into; the inclosed insect much wrinkled and shriveled, strongly convex medially, but flattened along the body margins, almost completely filling the sac, but probably shrinking very decidedly on the birth of the young; light brown, but mottled with piceous, and otherwise discolored.

Body of adult female.—Maximum length mounted on a slide, a little more than 2 millimeters; irregularly broad oval; maximum width, nearly 2 millimeters, most individuals somewhat smaller; antennæ 6- to 8-segmented, the lengths of the different segments quite variable, the measurements in microns as follows:

II.	III.	IV.	V.	VI.	VII.
21.4	32.1	21.4	19.6	10.7	12.5
21.4	39.3	17.8	14.3	10.7	12.5
32.1	25	42.8	17.9	14.3	14.3
28.6	25	25.7	17.9	14.3	14.3
32.1	30.4	32.1	17.9	14.3	10.7
25	43	17.9	17.8	10.7	10.7
32.1	26.8	39.3	17.9	12.5	10.8
28.6	25	[a]39.3	----------	14.3	17.9
21.4	25	25	19.4	17.9	[a]21.4
14.3	23.2	28.5	14.3	14.3	14.3
17.9	25	25	16.1	[a]21.4	

[a] With a pseudojoint.

Legs wanting; spiracles large and stout, placed at the body margin and continuous with a heavily chitinized, crescentic, marginal area at the outer or dorsal end of which is usually, with the posterior spiracle a single, and with the anterior spiracle

two, stout, usually slightly clavate, spiracular spines, none of these to be found in some specimens, and all probably easily broken off, these spiracular characters so easily disarranged in mounting that it is almost impossible to determine the exact relations; submentum apparently 1-segmented, broadly rounded apically; body margin with two rows of slender setæ, those in the lower row smaller, set relatively close together, the other row with the setæ much more widely separated, larger, the bases of the hairs in both about the same diameter, none of the larger setæ quite so long as the spiracular spines; with an occasional small dorsal seta; with numerous 8-shaped pores and elongate tubular ducts dorsally, these particularly crowded along the body margin; and with two groups of cribriform plates running cephalad, one on each side of the middle line, from opposite the anal ring region, these groups distinctly separated from each other, and each made up of numerous plates, the number of these varying considerably, but averaging around seventy to eighty; ventrally with a cluster of multilocular disk pores around and immediately posterior to the anal ring region, with some similar transversely scattered ones anterior to this, and with smaller quinquelocular pores in the chitinized marginal plate of each spiracle; anal ring about 54 to 64 μ long, nearly circular, broadly open behind, with ten large, flattened setæ, these as much as 132 μ long, and with a single row of pores, this anal ring surrounded by a heavily chitinized structure, with its upper and anterior half arched and its lower half broadened posteriorly on each side into a sort of triangular lobe with recurved posterior margin; with a pair of setæ in the bottom of the ventral groove thus formed and a pair, arranged longitudinally, on the posterior margin of each lateral lobe; in only one specimen, of those examined, with more than ten anal ring hairs, in this case with seven on one-half of the ring and five on the other, the extra setæ apparently resulting from the division of the two anterior ones of that side.

Intermediate-stage female.—Such intermediate-stage specimens as have been available for examination show only a lesser development of the adult structures, except that the cribriform plates are wholly wanting.

Larva.—Only embryonic larvæ have been available for examination, so only certain structures can be characterized. Antennæ 6-segmented, legs stout and short, total length about that of antennæ, the tarsal claw large, all four digitules long, slender and slightly knobbed at apices, the tarsal projecting a little beyond those of claw, both extending beyond apex of claw;

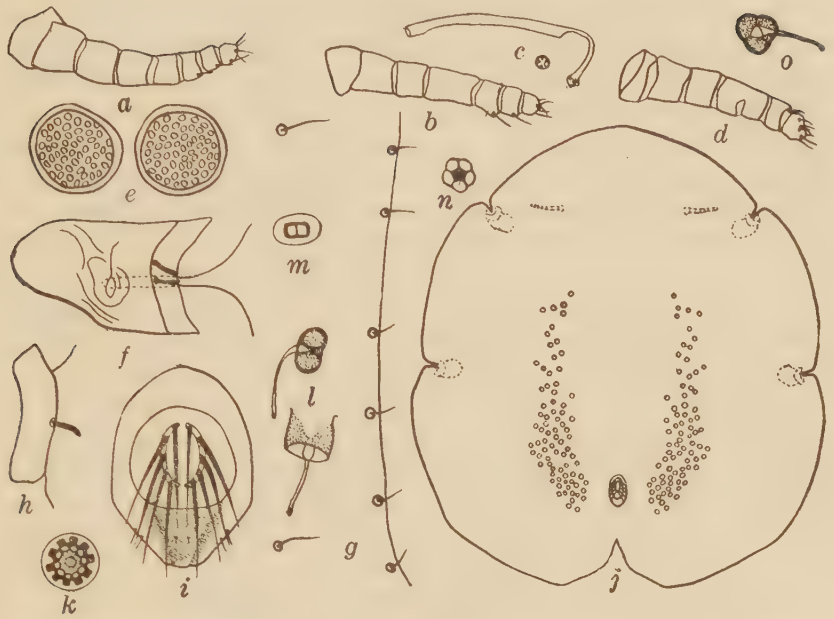

FIG. 2. *Anomalococcus multipori* sp. nov., adult female; *a*, antenna, showing eight segments, × 165; *b*, same, showing seven segments, × 165; *c*, tubular body duct, × 640; *d*, antenna, showing six segments, × 165; *e*, detail of two cribriform plates, × 640; *f*, anterior spiracle, with plate and spines, × 165; *g*, margin of body, showing size and position of two sizes of setæ, × 335; *h*, posterior spiracular plate, with single spine, × 165; *i*, anal ring, with surrounding chitinized band, × 165; *j*, outline of body, showing especially the position of the cribriform plates, ×20; *k*, anal multilocular disk pore, × 1,500; *l*, 8-shaped pore, side and diagonal views, × 1,500; *m*, same, dorsal view, another focal point, × 1,500; *n*, quinquelocular disk pore from spiracular plate, × 1,500; *o*, normal 8-shaped pore modified to form trilocular pore, × 1,500.

spiracles close to body margin, with two spiracular spines opposite anterior and one opposite posterior spiracles; body margin with a single row of slender setæ, about as long as spiracular spines, and set rather widely apart; the chitinous structure surrounding the anal ring well developed, quite plainly composed of a dorsal and ventral half, anal ring circular, with six setæ and two rows of pores; without anal lobes, but with a pair of long setæ at the apex of the body, these as much as one-third the body length; dorsally and at margin with a few longitudinal rows of minute 8-shaped pores, ventrally with similar rows of small setæ; with one or two tiny quinquelocular pores between each spiracle and the body margin.

This species has been described from twelve specimens and parts of specimens mounted on slides, and from additional unmounted material in position on the host, collected by Prof. C. F. Baker on stems of *Nephelium lappaceum* beneath ant cartons, under collection No. *9028*, and on the leaves of *Oncosperma*

horrida, collection No. *9026,* both from the Botanic Gardens, Singapore, October, 1917. The second lot of material is badly infested by an undeterminable fungus. The types are in the United States National collection of Coccidæ.

This species would be included in *Lecaniodiaspis* Targ., if one adhered strictly to the limitations of this genus and *Anomalococcus* as defined by Green,[3] but it is evidently so closely related to *A. cremastogastri* Green, the genotype, that it is certainly congeneric with it. From *A. cremastogastri* it is separable by a number of characters: The grouping of the dorsal cribriform plates into two longitudinal clusters, instead of a single transverse band; the persistence of the spiracular spines in the adult female; the occurrence of normally 7-segmented antennæ, instead of 8-segmented, although this structure shows the considerable variability noted in the description; the presence of a pair of spiracular spines opposite each anterior spiracle of the immature stages, instead of a single one; and the presence of a fairly complete tough test, or sac, in the adult stage.

Genus **PSEUDOCOCCUS** Westwood

Pseudococcus bromeliæ (Bouché).

This species, as it is at present identified, has been collected at quarantine, Washington, D. C., on pineapple plants, received from Singapore. The records are as follows: On *Ananas,* July 19, 1916, F. H. B. *18520* (coll. *H. Morrison*); on Rubby pineapple, August 18, 1916, F. H. B. *18730* (coll. *H. Morrison*).

Pseudococcus hispidus sp. nov.

Adult female.—Nothing regarding superficial appearance before mounting known (only two mounted specimens available for examination); length of body as mounted, a little more than 2 millimeters; width, about 1.5; oval, perhaps a little narrowed anteriorly and broadened posteriorly; derm clearing completely after treatment; antennæ normally 7-segmented, the measurements of those available as follows (in microns):

II.	III.	IV.	V.	VI.	VII.
50	43	46.5	32	35.7	87
57	43	50	35.7	39.3	85.6
50	(a)				
50	39.3	35.7	32	39.3	82

[a] Broken.

[3] Coccidae of Ceylon, pt. 4 (1909) 295, 297, 302.

The terminal segment longest, a little slenderer than the others; legs (only parts available) stout, heavy and short, the tarsal digitules normal, slender, long, slightly knobbed at apices, claw digitules probably similar, but broken, claw probably without denticle, but the extreme tips of those available for examination broken off, hind coxæ with numerous pores, hind tibiæ also with similar pores, but their extent not determin-

FIG. 3. *Pseudococcus hispidus* sp. nov., adult female; *a*, posterior apex of abdomen, showing anal ring, cerarii, pores, and unusually large dorsal setæ, × 165; *b*, hind coxa, showing both surfaces, × 165; *c*, large ventral multilocular disk pore, × 1,500; *d*, outline of body, showing number and position of cerarii, etc., × 30; *e*, foreleg, × 165; *f*, antenna, × 165; *g*, triangular pore, × 1,500.

able as only a fragment of a tibia is present; beak apparently 2-segmented; with both posterior and anterior pairs of dorsal ostioles well developed; with eighteen pairs of cerarii, each of these with more than two spines, these varying in size, and each with a loose cluster of triangular pores and with a few more or less distinctly associated accessory setæ, the posterior pairs, at least, and particularly the anal lobe cerarii, with a large chitinized area around the spines and pores; the number of spines in the cerarii of one of the two specimens studied as follows (beginning in front): I, 4–5; II, 4; III, 5; IV, 4–6; V, 5–6; VI, 4–5; VII, 3–6; VIII, 5; IX, 4; X, 4–5; XI, 4–6; XII, 5–6; XIII, 5–7; XIV, 6–7; XV, 5; XVI, 4–6; XVII, 6; XVIII, 3 (the last perhaps with more, as some of the spines and the setæ approach each other very closely in size and shape); anal lobes not developed, apical seta about as long as anal ring setæ (93 μ), but a little slenderer; dorsal thickening of posterior cerarius continued around the margin and onto the venter as a broadly rounded lobe, the anal seta situated on the inner side of this chitinization at the margin; anal ring oval, of normal pseudococcine appearance, with a double row of pores on each half and with six rather short setæ, the longest about 93 μ; with two pairs of rather long, slender setæ below the anal ring and between the apical cerarii, the longest of these about 71 μ; with numerous but scattered, small, triangular and trilocular pores both dorsally and ventrally, but somewhat more abundant dorsally, these in fairly distinct transverse rows on the abdomen, but apparently scattered without order anteriorly; ventrally near posterior apex of body with a few larger, multilocular disk pores; derm setæ rather numerous, although not in such quantity as to give a "hairy" appearance to the body, varying greatly in size, but all rather long, and either slender or stout, arranged in fairly distinct transverse rows on abdomen, and the center of the body dorsally with about four conspicuously larger setæ to each segment, these as much as 71.5 μ long, but less conspicuous anteriorly.

Immature stages.—None known.

This species has been described from two mounted specimens, kindly transmitted by Mr. E. E. Green, bearing the following information: "On Gordonia, Singapore, Malaya, coll. I. H. Burkill."

The type is in the United States National collection of Coccidæ; the paratype is in Mr. Green's collection.

Mr. Green had placed this species in *Tylococcus* Newst., and had given it the specific name *hispidus*, used above. As there is

very considerable question regarding both the validity and the characteristics of *Tylococcus* Newst., I consider it preferable to assign the species to *Pseudococcus*, for the present, at least.

TACHARDIINÆ

Genus **TACHARDIA** R. Blanchard

Tachardia aurantiaca Cockerell.

After a careful comparison with the type material of this species, three lots of specimens have been placed here. The most noticeable differences from the type lie in the size and shape, and the coloration of the test covering the insect, since in the Singapore specimens the test shows no traces of lateral ribbing and is more convex than type, approaching globular, with a practically uniform color which is much darker than that found in the typical *aurantiaca*. Morphologically the Singapore specimens appear to agree completely with the type, although none of the material available for examination has been in entirely satisfactory condition. The data for the lots examined are as follows: On *Acacia sphaerocephala*, Singapore (coll. *Burkill*), material received from Mr. E. E. Green; on *Cajanus indicus*, Botanic Gardens, Singapore, October, 1917 (*Baker 9027*); on *Ixora macrothyrsa*, Botanic Gardens, Singapore, August, 1917 (*Baker 8936*).

COCCINÆ

Genus **CEROPLASTODES** Cockerell

Ceroplastodes virescens Green.

This species is represented by a very small amount of material from "? *Artocarpus* sp.," Botanic Gardens, Singapore, October, 1917 (*Baker 9021*). These specimens agree exactly with Green's characterization of the color and surface texture of the test. The dried specimens are dark reddish brown, however; and, while the marginal spines may be considered as being typically three or even four deep, there are many points along the margin where they are quite plainly only two deep.

Genus **CEROPLASTES** Gray

Ceroplastes floridensis Comstock.

Ceroplastes floridensis Comstock, Green, Coccidae of Ceylon 4 (1909) 277.

A few specimens agreeing exactly with Green's description and figures, cited above, have been received from Professor Baker with the following data: On *Gleichena dichotoma*, Penang (coll. *I. H. Burkill*).

Genus **ALECANIUM** novum

Coccine form, female flattened, oval, with a median elevated ridge, covered by a transparent, thin, easily deciduous, waxy coat; antennæ and legs very much reduced, of the rudimentary type; derm not chitinized, only the mouth parts, spiracles, body margin, anal plates and a band surrounding these chitinized; the thickened margin deeply, irregularly incised, with a single row of long, slender setæ dorsally and an alternating double row of much stouter setæ ventrally; spiracular spines apparently wanting, their normal position indicated by quadrate chitinized plates; anal plates elongate, narrow dorsal surface bearing numerous setæ distributed over the whole plate surface, each plate terminating caudally in a single much longer seta; fringe setæ numerous, anal ring with ten to twelve setæ and pores, small, inclosed within the plates; derm with quinquelocular disk pores of two sizes ventrally, with tubular ducts with cup-shaped bases ventrally, with minute tubular ducts dorsally and with disk pores, possibly with loculi, dorsally grouped near the anal plates; larva elongate oval, antennæ 6-segmented, legs normal, with a single marginal row of slender setæ, three spiracular spines, approximately equal in length, in each group and anal plates similar in shape to those of the adult, slightly reticulate, but with only a long terminal and two or three other setæ.

This genus appears to differ from any other known to me in the characters of the anal plates and the marginal region of the body; it is, unfortunately, not possible to indicate any genus of the subfamily Coccinæ as a close relative of this one and little can be said at present regarding its probable position within that subfamily.

Type of the genus, *Alecanium hirsutum* sp. nov.

Alecanium hirsutum sp. nov. Plate 1, fig. 2.

Adult female.—Not definitely known to occur in the material studied, and possibly not observed; the form examined probably either the next to the last stage female, or the immature last stage; occurring on the twigs of the host, accompanied by male puparia; oval, somewhat pointed anteriorly, flattened dorsally, with a distinct, rounded, longitudinal ridge medially, the elongate oval pair of anal plates placed in this ridge about one-third of the total body length from the posterior end; body dorsally, irregularly wrinkled and pitted on each side of the median ridge; yellow-brown, more or less suffused with darker brown, anal

plates and the narrow chitinized ring surrounding them distinctly reddish; probably uniformly, moderately convex in life, without definite longitudinal ridge; covered by a thin, transparent, easily shed film of brittle wax, this appearing somewhat whitish when removed from the insect; maximum length of specimens examined, 1.75 millimeters.

Body of female.—Maximum length mounted on a slide, about 1.75 millimeters; body clearing when boiled in caustic potash, except for the anal plate and marginal regions; oval, somewhat pointed anteriorly, lateral margins slightly lobed due to shallow incisions opposite the spiracles; antennæ minute, rudimentary, indistinctly 3-segmented, the apex bearing a cluster of six setæ, some of these nearly as long as the whole antenna; preapical segment with at least one long seta, total length, averaging 36 μ; legs minute, rudimentary, broadly triangular from base to apex, the width at base, including the extended attachment sclerite, about 68 μ; the total length to apex of claw, about 25 μ, the divisions between the different parts so faintly indicated that it is impossible to trace them; with numerous relatively large chitinous circles, these the bases for the short setæ, present on the leg, claw present but poorly developed, both the tarsal and claw digitules present, relatively well developed, about 17 μ long; claw, about 5 μ long; beak apparently 1-segmented, short, stout and broad; spiracles rather large, placed nearer the margin than the center of the body, each connected with the margin by a line of scattered pores, which passes through a chitinous thickening at the edge and then barely up onto the upper surface; spiracular spines wanting in all specimens examined and no traces such as presence of chitinized bases visible; marginal spine and hair arrangement unusual, the margin just at the edge or a very little on the dorsum with a row of relatively long, slender, hairlike setæ, below this broken up by deep irregular incisions and crenulations, some of which extend the whole width of the chitinized portion, and bearing, usually on the inner portion of the chitinization, an unevenly spaced and irregularly placed row of stout but long setæ, these about half the length of the dorsal setæ or a little more, and as much as two or even three deep at the posterior end of the body; dorsally with fairly numerous but scattered setæ, similar in shape and base to those occurring dorsally at the margin, but smaller, present over the whole surface, slightly larger near the margin than near the middle; ventrally with more numerous, similar, but smaller setæ, those just anterior to the anal plates arranged in fairly definite straight transverse rows;

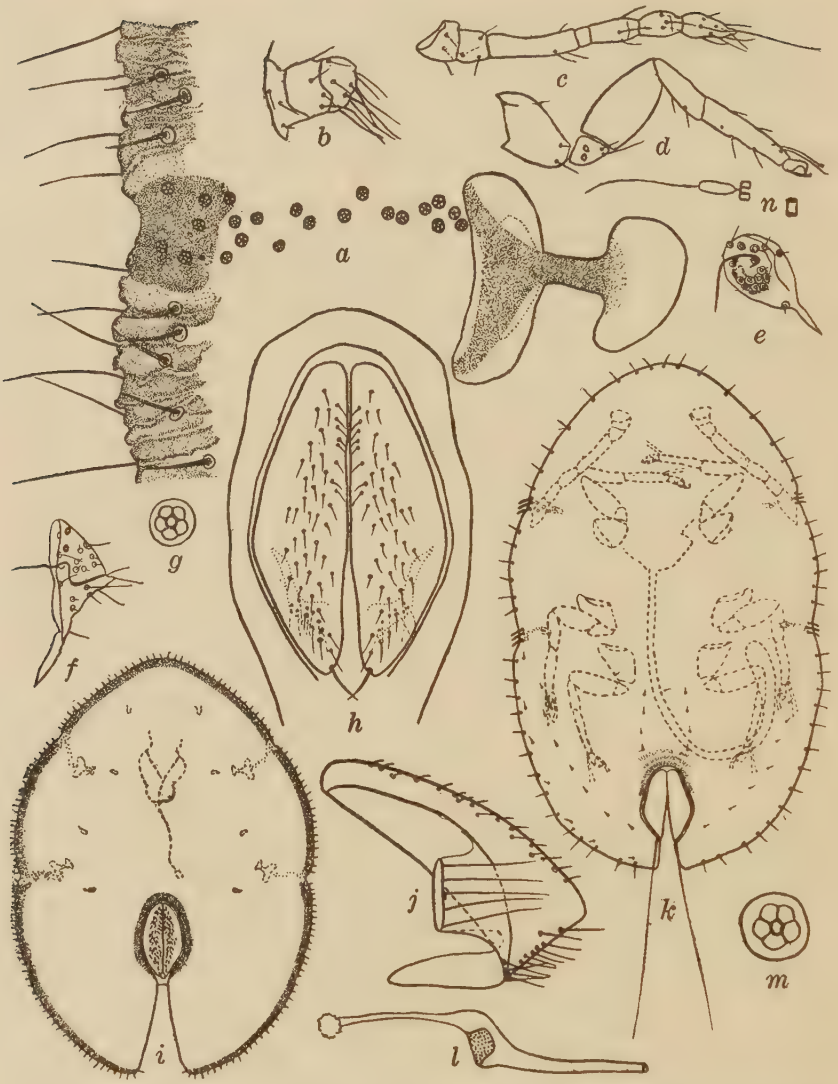

FIG. 4. *Alecanium hirsutum* g. et. sp. nov.; *a*, adult female, body margin opposite spiracle, × 335; *b*, adult female, antenna, × 335; *c*, larva, antenna, × 165; *d*, larva, leg, × 165; *e*, adult female, disk pore from spiracular row, × 1,500; *h*, adult female, anal plates, × 165; *i*, adult female, outline of body, × 30; *j*, adult female, anal plates, lateral view, somewhat diagrammatic, × 165; *k*, larva, outline, × 90; *l*, adult female, ventral tubular duct, × 1,500; *m*, adult female, quinquelocular disk pore from anal plate region, × 1,500; *n*, adult female, dorsal pore, × 1,500.

dorsally with numerous, but well-separated and scattered, minute, circular to quadrate pores over the whole surface, these with small internal ducts and long internal filaments, and with somewhat larger but unequal-sized pores with heavy borders in scattered groups on each side of the anal plates, the groups ex-

tending both anterior and posterior to the plates, and having the appearance of poorly constructed bi-, tri-, or quadrilocular pores, with a circular or slightly oval outline; ventrally with at least two types of pores, the circular disklike multilocular pores, apparently all quinquelocular, a small row running from each spiracle to the body margin, and a few, widely separated, for some distance around the anal plates, the nearest approach to grouping coming just posterior to the plates, the latter noticeably larger than the first, and the elongate, slender, tubular ducts with deep asymmetrical cup-shaped bases, most numerous along the margin, here apparently opening into the margin itself, and again somewhat more numerous along the median ventral line anteriorly, but scattered more or less over the whole surface; anal plates surrounded by a narrow chitinous band about as long as the whole of the mouth parts, plates about 265 μ long, and each about 80 to 85 μ wide, bluntly rounded anteriorly, more or less pointed posteriorly, widest at a point about one-third of the total length from the posterior apex, the outer angle rounded or very bluntly angular, dorsally with numerous, rather long, slender setæ scattered from base to apex, arranged in very indefinite transverse and usually diagonal rows, the number varying from forty to fifty-three, with forty-four or forty-five as the commonest number, each plate with a large apical seta about twice as long as the dorsal setæ, with six to eight somewhat stouter setæ on the short posterior ventral ridge, the inner lower corner of the ridge attached to a chitinized plate which extends downward and cephalad along the median line, and together with the anal plates completely incloses the anal ring, except for the narrow dorsal and apical slit between the plates; this chitinized plate bearing eight or nine setæ at its upper posterior extremity, these appearing to correspond to the fringe setæ found in other species, and standing two or sometimes three deep; with a cluster of small spinelike setæ visible in mounts just posterior to the apex of the anal plates, these possibly homologous with the hypopygial setæ of some other species, but more probably merely a group of ventral setæ; anal ring small, placed within the posterior half of the anal plates, the setæ about a third or a little more of the plate length, the total number varying from at least ten to twelve, the ring itself with a double to triple row of pores.

Larva.—Oval, pale brown in dried condition, flat, naked; length, about 0.77 millimeters; width, about 0.48; becoming clear when boiled in caustic potash; legs and antennæ well developed, the

former 6-segmented, the third segment longest, somewhat curved and slightly clavate, nearly twice as long as the terminal which is next longest; legs with all the parts well developed, the tarsus distinctly longer than the tibia, the tarsal digitules much longer than those of the claw, slender, both slightly knobbed, extending just beyond the apex of the claw, this faintly denticulate close to the apex; spiracles elongate, rather slender, slightly enlarged at each end; three spiracular spines opposite each spiracle, nearly equal or the middle one very slightly longer; margin with a single row of fairly large setæ, these spaced irregularly, and with an occasional much smaller submarginal seta ventrally; dorsally with at least a single row of very small setæ extending cephalad from the anal plates on each side and about halfway between margin and median line, the individual setæ widely separated, only about six altogether; ventrally with two similar rows on each side, the setæ in these slightly larger; without pores except for three or four quinquelocular disk pores between each spiracle and the margin; anal plates elongate, each about 100 μ long and 32 μ wide, broadly rounded anteriorly, tapering to a point posteriorly, broadest just caudad of the middle, the apical hair very long, slender, about 268 μ long; plates with a single tiny seta at a point about one-third the length from the anterior apex, another about the same distance from the posterior apex, both close to the inner margin of the plate, and a larger subapical seta at the outer margin and just anterior to the apical seta; with a single rather large seta at the base of the ventral ridge, with a single rather large fringe seta below the plate on each side; anal ring and hairs located in the middle of the anal plates, the hairs a little more than half the length of the plate, apparently six in number, this not definitely determinable.

Male puparium.—Elongate oval, fairly convex, about 1.25 millimeters long, broadest opposite the anal plates, of thin transparent wax, only the slightly flattened margins whitish; the lines indicating the plates faint, with a submedian on each side dorsally, the others all quite indistinct, with traces of a cross-line probably joining these two just before the anal plates and another close to the cephalic apex, and additional lines running diagonally from these meeting points to the body margin, occasionally with traces of a line dividing each lateral plate into anterior and posterior parts; without any traces of transverse dorsal carinæ.

Male pupa and larva (second stage).—The inclosed male pupa almost uniformly reddish brown, shaped much as is the

puparium; the poorly developed male pupa surrounded by the larval skin, but whether this condition continues through the entire pupal period cannot be stated; the male larval structure appears intermediate between the young larva and the oldest female form as already described; legs and antennæ much reduced; anal plates elongate, slender, with about seven or eight dorsal pores, possibly bearing setæ, scattered through the whole length of the plate; apical seta broken; with two relatively large fringe setæ on each side; with three spiracular spines of equal length in each group; marginal spine arrangement much as in young larva; multilocular disk pores observed only between spiracles and margin; cup-shaped tubular ducts numerous, especially along the margin and, in transverse groups, on each side anterior to the anal plates; the short developing legs and antennæ of the male pupa about twice as large as those of the larva; the pupa not sufficiently developed to show any characters for description.

This species has been described from five females mounted on a slide, five young larvæ mounted on a slide, two male larvæ and pupæ mounted on a slide, and a number of specimens attached to the host. The specimens were found on *Alsodeia echinocarpa*, Botanic Gardens, Singapore, August, 1917 (*Baker 8935*) and were covered by a carton and attended by ants. The types are in the United States National collection of Coccidæ.

I have described this material as representing a new genus and species with great hesitancy, as there is considerable evidence to indicate that the species may be founded on the immature female. There is no evidence of the development of the ovaries in any of the specimens examined, the difference in size of young larva and the largest female found is much less than might be expected normally, and the male puparia are much larger in proportion to the size of the largest female than is usual in the subfamily. In spite of this, however, the differences noted, particularly with reference to the anal plates and the marginal region, are such as to indicate a considerable divergence from the typical condition in the subfamily; and, assuming that the females described are only second or preadult stage, any further modifications of structure in the adult might reasonably be expected to follow along the lines shown by the form described.

Genus COCCUS Linnæus

With the possible exception of the first, the species that are placed in this genus in this paper are a decided puzzle in respect

to their true generic relationships. The whole group of new species described here have a similar habit and are evidently closely related, possibly excluding the first new species, and in view of the chaotic condition of the genera of the Coccinæ it has seemed advisable to place them in a well-known genus, from which they can be readily transferred to their proper position if this should prove necessary.

Coccus discrepans (Green).

This record is based on some specimens from the undersides of leaves of *Murraya caloxylon,* Botanic Gardens, Singapore, August, 1917 (*Baker 8940*), the individuals attended and covered by ants. These specimens have been compared with mounts made from material forwarded to the United States National collection of Coccidæ from Ceylon by Mr. E. E. Green, the describer of the species. Green lists this species as belonging to the genus *Saissetia* as recognized by the Fernald Catalogue of Coccidae; but from an examination of the material at hand, I can see no reason for not including it in *Coccus* as this genus is at present recognized by American coccidologists. The only structural differences noted in the Singapore specimen, as compared with the description and the Ceylon specimens, are that the anal plates are wider in proportion to their length in the former than in the latter and that no submarginal tubercle has been located between the groups of spiracular spines on the Singapore specimens, although they are present elsewhere. Both of these apparent differences are in all probablity due to the condition of the mounts obtained from the specimens from Singapore, since all these have been rather poor and have apparently been so badly crushed in mounting that the anal plates have been flattened.

For the present another lot of specimens, from the leaves of an unknown host, Singapore, August, 1917 (*Baker 8934*), colonized by ants under carton nests, is also considered as of this species, although these specimens show some structural differences as compared with the other specimens of the species that have been examined. There are six well-developed submarginal tubercles on each side, two anterior to the first spiracle, one between the spiracles, and three posterior to the second spiracle, all widely separated. The body of the female, which is fully developed, as evidenced by the presence of young larvæ beneath it, averages about one-fourth smaller than the Ceylon specimens; and, while the marginal setæ are frayed apically and curved as in the typical specimens from Ceylon, the two lateral spiracular spines are

quite noticeably smaller in proportion to the length of the middle spine in this lot of specimens as compared with typical material.

Coccus tumuliferus sp. nov. Plate 1, fig. 3.

Adult female.—Occurring within the hollow stems of the host, probably attended by ants; rarely broad oval, but usually broadened behind and triangular with the angles rounded; plane of dorsal surface flat, but in dried specimens covered with relatively large knobs having a fairly definite arrangement of a median longitudinal single row and on each side of this two other rows, the outer one forming a continuous row around the body at the margin; dorsally covered with a thin, brittle, whitish but more or less translucent, glassy secretion, very easily broken and usually more or less wanting, molded into elevations and depressions corresponding to those of the body, this covering normally wanting over the flattened extreme margin of the body; body color dull brown, of secretionary covering, as stated, translucent whitish; maximum length noted, 2 millimeters; width, 2; body as mounted on slide similar in shape and size to unmounted specimens; derm in fully matured individuals becoming somewhat chitinized, more especially along the margin where the inner border of the chitinized zone is broadly scalloped, corresponding to the borders of the adjacent knoblike elevations, the tongues of these scallops continued inward and united with a chitinized pattern corresponding exactly with the deep grooves running between the conspicuous body knobs; antennæ normally 8-segmented, the measurements of those available for study as follows (in microns): II, 43–50; III, 39–43; IV, 32–35.7; V, 18; VI, 16–18; VII, 14; VIII, 18–21; legs of normal form, rather small and slender, claw rather stout and strongly curved, without denticle, all digitules slender, threadlike, with slightly swollen tips, spiracles not unusual, placed rather near the body margin and each with a slight depression in the margin opposite it; with a wide band of scattered pores between spiracle and margin; mentum apparently 1-segmented, short, and broad triangular, apex rounded; derm pores of several sorts, tiny tubular ducts scattered over the dorsum, large tubular ducts with cup-shaped inner ends mostly close to the body margin, and a very few circular disk pores, apparently simple, in line anterior to the anal plates; ventrally with multilocular disk pores of two sizes, a few large, with eight to ten loculi beneath the anal plates, the others smaller, normally with five loculi in wide bands between spiracles and margin; marginal setæ long, slender, hairlike, in a

scattered and irregular row, this at times appearing double, and with a number of somewhat smaller submarginal setæ; apparently without dorsal setæ, ventrally with a number of setæ, much smaller and stiffer than those of margin, these appearing as if scattered, but probably actually in transverse rows, and largest near the antennæ and anterior to the anal plates; spiracular spines possibly normally occurring in threes, but no more than one noted opposite each spiracle in any of the specimens examined, this fairly long and stout, but much shorter

FIG. 5. *Coccus tumuliferus* sp. nov.; *a*, adult female, antenna, × 165; *b*, larva, leg, × 335; *c*, larva, antenna, × 335; *d*, adult female, large tubular duct, × 1,500; *e*, adult female, spiracular disk pore, × 1,500; *f*, adult female, small tubular duct, × 1,500; *g*, adult female spiracular and marginal spines, × 640; *h*, larva, outline, × 115; *i*, larva, spiracle to margin, × 640; *j*, adult female, anal plates, × 220; *k*, adult female, claw, × 500; *l*, larva, anal plates, × 335; *m*, adult female, posterior ventral disk pore, × 1,500.

than the marginal setæ; anal plates triangular, posterolateral margin somewhat shorter than anterolateral, the corners usually rounded; plates high and, consequently, subject to considerable distortion on mounting; dorsally with as many as twenty-four small slender setæ scattered over the posterior two-thirds of each plate, with three or four ventral ridge setæ, somewhat larger than the dorsal setæ, and with two pairs of relatively large and long fringe setæ; anal ring placed below and within the

plates, small, stout, with pores and eight relatively large and long setæ; no hypopygial setæ.

Intermediate-stage female.—Similar to adult, except for smaller size, reduced number of pores and setæ, and the presence of a pair of stout spiracular spines, one larger than the other, opposite each spiracle.

Larva.—Oval, tending toward oblong, antennæ 6-segmented, the third longest; legs normal, rather slender, claw long, slightly curved at apex, with denticle, digitules long and slender, slightly knobbed; margin of body with a row of rather widely separated slender setæ; spiracular spines three in each group, two short, rounded-conical, one, the median, much larger and cylindrical, all about same diameter at base; with a ventral submarginal row of smaller setæ, and a few longer, very slender ones anterior to the anal plates and near antennæ; with three or four quadrilocular pores between each spiracle and margin, no other pores noted; anal plates triangular, slender, with a large and long apical seta, three much smaller subapical marginal setæ and one ventral ridge seta on each.

This species has been described from five mounted adults, several mounted larvæ, and a number of unmounted specimens, all received from Mr. E. E. Green with the following information: In hollow stems of *Macaranga hypolema,* Singapore (coll. *I. H. Burkill*). The name used above is the manuscript one assigned to the species by Mr. Green, who had also tentatively assigned the species to the genus *Ctenochiton* Mask. I have examined the type of this genus and consider the correctness of such an assignment to be very questionable, and consequently I have placed the species in the genus *Coccus,* though from our present knowledge of the genera of the Coccinæ there is little more to be said in favor of its location here than in *Ctenochiton.* The species itself appears to be a very distinct one, and there should be little danger of confusing it with other species that have been assigned to *Coccus.* The most conspicuous characters are the external appearance, the size and shape of the marginal setæ, the number and size of the spiracular spines, and the numerous dorsal setæ on the anal plates. The types are in the United States National collection of Coccidæ.

Coccus penangensis sp. nov.

Adult female.—Normally short oval, flat, dorsal surface dull, naked, wrinkled radially near margin, outer portion light brown, central disk usually much darker brown to blackish; maximum length, about 2.5 millimeters; width, a little less than 2; mounted

specimens similar in size and shape; derm clearing to a considerable degree on treatment with caustic potash, but showing more or less distinctly numerous, large, rather closely crowded areolations, each with a tiny pore, these areolations similar to those found in species of *Saissetia,* but much less conspicuous on account of the much lighter chitinization, more pronounced along the body margin; antennæ normally 7-segmented, the third sometimes incompletely divided, the measurements of those examined as follows (in microns): II, 35–39; III, 39–48; IV, 35–37; V, 22; VI, 18–22; VII, 35–39; legs normal, rather small and slender, claws rather strongly curved at tips, digitules all long, slender, knobbed at tips, but one of claw about three times as thick as the others; spiracles not unusual; beak apparently 1-segmented, very short; derm with numerous, but scattered simple pores over dorsum in center of areolations,

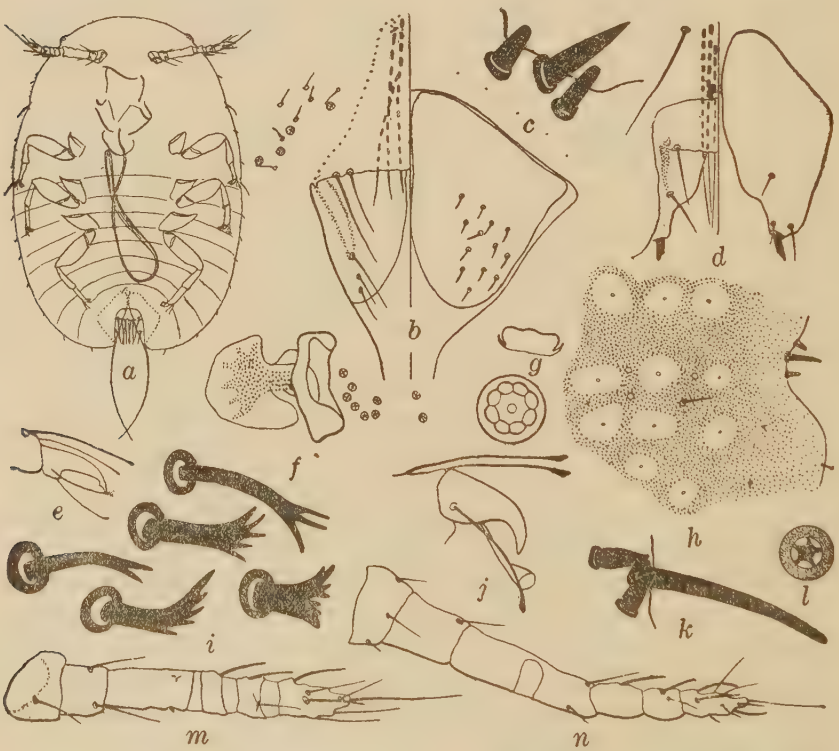

FIG. 6. *Coccus penangensis* sp. nov.; *a*, larva, outline from beneath, × 115; *b*, adult female, anal plates, × 220; *c*, adult female, spiracular spines, × 640; *d*, larva, anal plates, × 335; *e*, larva, claw, × 640; *f*, adult female, spiracle, × 220; *g*, adult female, posterior disk pore, × 1,500; *h*, adult female, portion of derm showing areolations, × 220; *i*, adult female, marginal setæ, showing range of variation, × 1,500; *j*, adult female, claw, × 640; *k*, larva, spiracular spines, × 1,500; *l*, adult female, spiracular pore, × 1,500; *m*, larval antenna, × 440; *n*, adult female, antenna, × 220.

laterally with small long-tubular ducts with cup-shaped bottoms; ventrally with a row of quinquelocular pores between each spiracle and margin, and with a few somewhat larger disk pores, each with about eight loculi, below the anal plates; body with rather variable, but usually fairly stout, short, marginal setæ, normally bifid, trifid, or fringed at apices, rarely with one or more lateral teeth; spiracular spines normally in threes, with one plainly but not conspicuously longer than the other two, rarely with four in a group, the median rather sharp conical, the laterals rounded conical; dorsal surface with an occasional, isolated, fairly long, slender but stiff seta, these setæ probably in definite arrangement, but this not determinable from the material at hand; ventrally with the setæ more numerous and, in general, smaller than dorsally, but with a few, anterior to anal plates and near antennæ, much larger; anal plates rather broadly triangular, but much subject to distortion in mounting, the apical angle rounded, dorsally bearing about sixteen to eighteen short, rather stiff setæ on the apical half of each plate, ventrally with three larger setæ on the ridge, and a pair of still larger fringe setæ on each side; no hypopygial setæ; anal ring with pores and eight setæ.

Larva.—Rather stout oval, antennæ 6-segmented, legs rather stout, margin of body with widely separated slender setæ, spiracular spines in threes, the median much longer than the laterals; anal plates triangular, with a long apical seta, about three subapical dorsal setæ, a single larger ventral seta and a single large fringe seta.

This species has been described from two mounted adults, three mounted larvæ, and a few unmounted specimens, all of the material kindly transmitted by Mr. E. E. Green and bearing the following information: In hollow stems of *Macaranga triloba*, Penang Ids. (coll. *I. H. Burkill*). The types are in the United States National collection of Coccidæ.

The salient characters which distinguish this species from the closely related forms found in similar situations and in the same locality are indicated in the key which follows this series of descriptions of new species of *Coccus*.

Coccus caviramicolus sp. nov. Plate 1, fig. 4.

Adult female.—Flat, broad oval, approaching circular, dull brown, central area darker, dull or faintly shining, without or with a very slight secretionary coating; maximum length, 2.5 millimeters; width, about 2; individuals mounted on slides similar in size and shape; some individuals showing faint traces

of areolations similar to those described for *C. penangensis,* mostly near the posterior apex of the body; antennæ normally 7-, rarely 8-segmented, the measurements of the 7-segmented form in microns as follows: II, 43; III, 53.5–60.5; IV, 27–39; V, 14–18; VI, 18–21.5; VII, 44–50 (3 antennæ); of the 8-segmented form: II, 46.5; III, 43; IV, 18; V, 14; VI, 21.5; VII, 25; VIII, 46.5; legs not unusual, claws without denticle, one digitule about three times as large as the other, all elongate, slender, knobbed at apices; spiracles normal; derm dorsally with numerous, scattered, tiny quadrate pores with internal tubular prolongations, also with

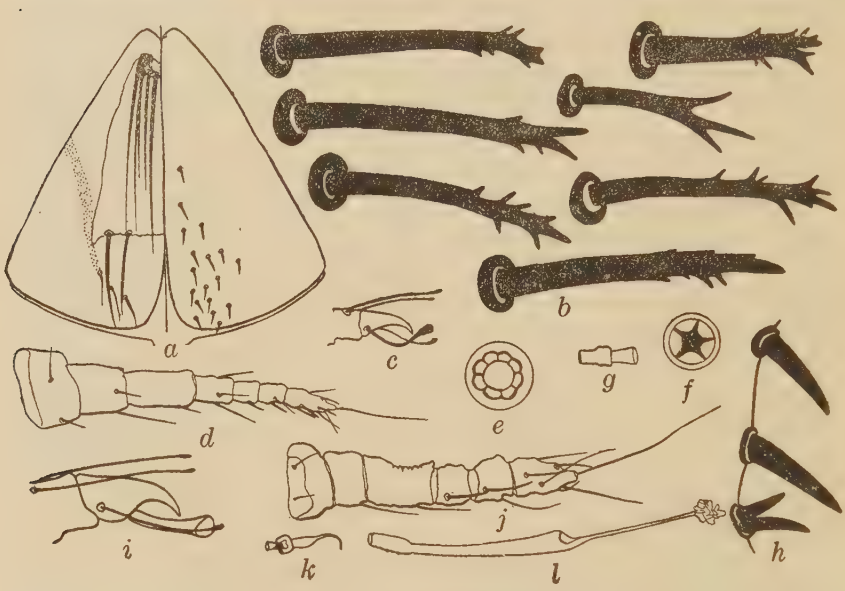

FIG. 7. *Coccus caviramicolus* sp. nov.; *a*, adult female, anal plates, × 220; *b*, adult female, marginal setæ, × 1,500, showing range of variation; *c*, larva, claw, × 460; *d*, adult female, antenna, × 165; *e*, adult female, posterior ventral disk pore, × 1,500; *f*, same, spiracular disk pore, × 1,500; *g*, adult female, ventral tubular duct, × 1,500; *h*, adult female, spiracular spines, × 640; *i*, adult female, claw, × 640; *j*, larva, antenna, × 440; *k*, adult female, dorsal tubular duct, × 1,500; *l*, adult female, long tubular duct, × 1,500.

a few larger, scattered, simple disk pores anterior to anal plates; ventrally with some tiny, short tubular ducts, some larger, long tubular ducts near the body margin, with a narrow band of quinquelocular disk pores between each spiracle and the margin, and with a few somewhat larger disk pores beneath the anal plates, these with six to eight loculi; marginal setæ fairly large and stout, nearly as long as the spiracular spines, the apical third of each more or less strongly frayed laterally and apically; spiracular spines normally in threes, the median somewhat larger, rarely with four present, all stout, tapering, pointed at

tips; ventrally with a submarginal row of fairly large, slender, entire setæ, and with others near antennæ and anterior to anal plates; no dorsal setæ noted; anal plates triangular, the anterolateral margin of each longer than the posterolateral, but the shape of the plates much subject to distortion through mounting, inner and posterior half of each plate with about seventeen to twenty small setæ; ventral ridge with three larger setæ and with two pairs of much larger fringe setæ, the inner smaller; anal ring small, with pores and ten setæ.

Larva.—So far as can be determined from the very limited material available, the larva is entirely similar to that of *C. penangensis,* previously described.

FIG. 8. *Coccus secretus* sp. nov.; *a*, adult female, anal plates, × 220; *b*, adult female, spiracular spines, × 640; *c*, adult female, derm dorsally immediately anterior to anal plates, × 220; *d*, larva, claw, × 640; *e*, adult female, claw, × 640; *f*, adult female, antenna, × 335; *g*, adult female, marginal setæ, × 1,500.

This species has been described from the following specimens mounted on slides: One adult (holotype) from hollow stems of *Macaranga* sp., Singapore (*I. H. Burkill X-2*); two adults, in hollow stems of *Macaranga triloba,* Kendong, Malacca, Malay Peninsula (*I. H. Burkill 1440*); one adult, in hollow stem of *Macaranga triloba,* foot of Tampin Hill, north of Malacca, Malay Peninsula (*I. H. Burkill 1331*); one intermediate stage, the same; one late larva, the same; and from one or more unmounted specimens of each of these lots of material, all of which was received from Mr. E. E. Green. The types are in the United States National collection of Coccidæ.

The salient characters of the species are indicated in the key at the end of this series of descriptions of new species.

Coccus secretus sp. nov.

Adult female.—Slightly longer than wide, flat, the center usually slightly elevated, with faint radiating ridges around the margin, dirty pale brown, appearing as if covered with a thin film of dust; maximum length, 1.75 millimeters; width, 1.5; usually a little smaller than this; body as mounted similar in shape and size; derm clearing completely on treatment with caustic potash, without traces of the *Saissetia*-like areolations of some related species; antennæ small, normally 6-segmented, the measurements of the segments in microns as follows:

II.	III.	IV.	V.	VI.
11	45	12	12	29
11	43	15	[a]	----------
14	43	18		32
14	39	14	14	29
14	39	12.5	12.5	32
14	36	12.5	14	32
14	40	21		27
14	32	18		27
14	43	14	14	32
14	32	14	14	32
14	25	7	9	25
14	25	11	11	27
14	28.5	11	11	25
11	36	8	11	25
11	36	11	11	25

[a] Broken.

Legs small, normal, the digitules slender, knobbed, that on claw larger and heavier than the other; spiracles not unusual, placed rather near body margin; derm dorsally with a fairly close cluster of relatively large, circular to oval, apparently simple pores placed just anterior to anal plates, and with numerous other much smaller circular pores (probably the openings of tiny tubular ducts) scattered almost uniformly over the dorsal surface; ventrally with long tubular ducts with cup-shaped bottoms near margin, with quinquelocular disk pores between each spiracle and the margin and with larger disk pores, usually with eight loculi, beneath the anal plates; marginal setæ large, entire, stout and stiff, tapering to a blunt point, each set in a heavy socket, and separated from adjacent spines by, usually, more than its own length; spiracular spines in threes, stout, the laterals tapering to a rounded apex, about as long as the marginal setæ, the median plainly but variably longer, tapering to a sharper point; dorsally with an occasional small seta, ventrally

with somewhat more numerous and larger, but scattered setæ, and with a few pairs, still larger, anterior to anal plates and near antennæ, anal plates triangular, the anterolateral margin more or less distinctly longer than the posterolateral, the angles, especially the outer, rounded; dorsally with eight to ten comparatively large, stout setæ, scattered through the posterior two-thirds of each plate; with a single larger ventral ridge seta and two pairs of fringe setæ, the outer of these larger; anal ring with pores and six setæ.

No other stage has been available for examination.

This species has been described from ten mounted adults having the following information: "In hollow stems of *Macaranga triloba,* Penang Id. (*I. H. Burkill 2693a*)" (holotype and paratypes) and "in hollow stems of *Macaranga,*" Singapore (*I. H. Burkill 1318*) (paratypes). Certain differences in these two lots of material, notably a little greater length to the dorsal anal plate setæ and the middle spiracular spines of each group, have been noted, but nothing that I can consider as sufficient to justify even varietal segregation. The types are in the United States National collection of Coccidæ.

The salient characters of the species are indicated in the key following this series of descriptions of new species.

Coccus macarangæ sp. nov. Plate 1, fig. 5.

Adult female.—Short oval, pale reddish brown, darker in middle, flat, with faint radiating ridges near margin; dorsal surface appearing naked, possibly with a very thin film of secretion; maximum length, 3.25 millimeters; width, 2.25; size and shape when mounted similar; derm clearing almost completely, but retaining indistinct traces of an areolation similar to that developed in *C. penangensis,* especially around the margin and anteriorly; antennæ normally 8-segmented, the measurements of the single entire example available for examination as follows (in microns): II, 36; III, 36; IV, 21.5; V, 34; VI, 18; VII, 21.5; VIII, 33; legs normal but small, the digitules slender, knobbed, one of tarsus somewhat larger than the other; spiracles not unusual; derm dorsally with a rather conspicuous but irregular cluster of relatively large, circular, simple pores anterior to anal plates; elsewhere over the dorsum with numerous and rather uniformly scattered tiny circular pores, the openings of minute tubular ducts; ventrally near margin with long tubular ducts with cup-shaped inner ends, these also unusually small,

FIG. 9. *Coccus macarangæ* sp. nov.; *a*, adult female, anal plates, × 220; *b*, adult female, derm showing areolation, × 220; *c*, larva, claw, × 640; *d*, adult female, derm anterior to anal plates, showing dorsal circular pores, × 57.5; *e*, adult female, derm and spiracular spines, × 220; *f*, adult female, marginal setæ, showing range of variation, × 1,500; *g*, adult female, claw, × 640; *h*, adult female, spiracle, × 220; *i*, adult female, antenna, × 220; *j*, larva, antenna, × 440; *k*, adult female, spiracular spines, × 640.

with quinquelocular disk pores between spiracles and margin, and slightly larger disk pores with six to eight loculi beneath anal plates; dorsally with a number of rather large, stiff setæ, scattered apparently indefinitely; ventrally also with scattered setæ, these smaller and perhaps a little less abundant; marginal setæ appearing rather delicate, elongate, the terminal portion ragged or frayed, about as long as or even shorter than dorsal setæ and on the average about as long as lateral spiracular spines; the latter in threes, the middle distinctly longer than the other two, all stout, tapering to a bluntly rounded tip, the bases of the laterals usually somewhat swollen; anal plates triangular, the angles rather sharply rounded, with four rather long dorsal setæ placed close to the apex of each plate, three ventral ridge setæ and two pairs of much larger fringe setæ, the latter nearly equal in size; anal ring with pores and, apparently, eight setæ.

Larva.—Apparently entirely similar to those of closely related species.

This species has been described from a single mounted adult female, several mounted embryonic larvæ, and two unmounted adults, all "in hollow stems of *Macaranga*, Selander forest, Singapore" (*I. H. Burkill 1319*), received from Mr. E. E. Green. The types are in the United States National collection of Coccidæ.

The more prominent salient characters of this species are indicated in the key following this series of descriptions of new species.

Coccus circularis sp. nov. Plate 1, fig. 6.

Adult female.—Nearly to quite circular, dull grayish, appearing as if sprinkled with gray powder or dust; flat, but slightly ridged transversely about the middle and with low radiating ridges around the margin; anal cleft a little less than one-third the body length; extreme margin of body slightly elevated all the way around, forming a more or less distinct marginal ridge; maximum length, 3 millimeters; width the same; body, as mounted on slide, similar in size and shape to the unmounted form; without traces of dermal areolation in the specimens examined; antennæ normally 7-segmented, the lengths of the segments in microns as follows:

II.	III.	IV.	V.	VI.	VII.
40	46.5	40	12.5	18	46.5
46.5	46.5	36	14	21	50
50	46.5	40	18	18	46.5
50	57	40	14	18	46.5
50	43	43	14	14	43
43	50	36	14	18	46.5

Legs normal, small, spiracles normal; derm dorsally with an occasional small, circular, simple pore, these scattered widely anterior to the anal plates, and with numerous, scattered, very tiny, tubular ducts over much of the surface; ventrally near margin with numerous large tubular ducts with cup-shaped inner ends, with a row of quinquelocular pores between each spiracle and the margin, and with a number of somewhat larger disk pores with six to eight loculi beneath the anal plates; marginal setæ fairly large, stiff, normally simple and tapering to the apex, but occasionally cleft to form two unequal prongs near apex; spiracular spines in threes, the middle one distinctly but not prominently the longest, all stout in basal portion, but tapering to a rounded point at apex; dorsally with an occasional rather large, stiff, pointed seta, ventrally with submarginal setæ

and others anterior to the anal plates and near antennæ; anal plates triangular, the anterolateral margin longer than the posterolateral, the angles rounded, with about six rather long (as compared with related species described herewith) apical and subapical setæ, with three or four ventral ridge setæ, also relatively large, and two pairs of larger fringe setæ; anal ring with pores and ten setæ, of which two pairs are smaller than the others; no hypopygial setæ.

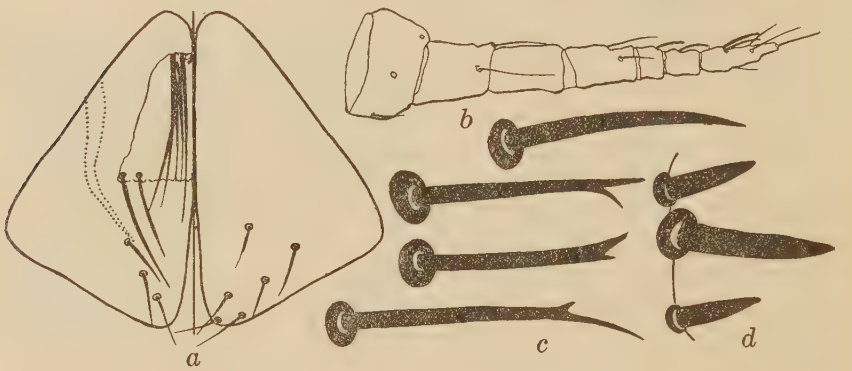

FIG. 10. *Coccus circularis* sp. nov., adult female; *a*, anal plates, × 220; *b*, antenna, × 220; *c*, marginal setæ, showing range of variation, × 1,500; *d*, spiracular spines, × 640.

Larva.—So far as can be determined from a single not very good mounted specimen, the larva is identical with those of already described species.

This species has been described from three mounted adults, two, including the holotype, in hollow stems of *Macaranga* sp., Singapore (*I. H. Burkill 1389*), one in hollow stems of *Macaranga triloba*, Singapore (*I. H. Burkill 1396*); from a single larva from the same material as the two adults; and from a very few unmounted specimens also from this first lot of material. The types are in the United States National collection of Coccidæ.

The more conspicuous salient characters of this and the preceding newly described species are indicated in the following key:

Key to new species of Coccus Linnæus.

a^1. Anal plates with numerous (12 to 24) small dorsal setæ; without a distinct cluster of heavy disk pores anterior to anal plates; anal ring with eight or ten setæ.

b^1. Dorsal surface of body with numerous, large, rounded-conical elevations in definite arrangement; marginal setæ long slender hairs, at least twice length of spiracular spines; dorsum with a brittle, glassy coating, molded to conform to elevations and depressions of body; anal ring with eight setæ..... C. tumuliferus sp. nov.

b^2. Dorsal surface flat, at most slightly wrinkled radially around margin; without elevations or a distinct glassy secretion; marginal setæ much shorter and stouter, not conspicuously longer than spiracular spines.

c^1. Marginal setæ short, comparatively stout, and usually strongly fimbriate at apices; anal ring with eight setæ.
C. penangensis sp. nov.

c^2. Marginal setæ longer, slenderer, sometimes entire, usually frayed along both sides near apices; anal ring with ten setæ.
C. caviramicolus sp. nov.

a^2. Anal plates with a few, larger, dorsal setæ, usually four to six; if with as many as ten then with a distinct cluster of circular disk pores anterior to anal plates, and anal ring with six setæ.

b^1. Marginal setæ stiff, straight, entire, tapering to bluntly pointed tips; with cluster of simple, heavy disk pores anterior to anal plates dorsally; plates each with nine or ten dorsal setæ; anal ring with six setæ..... C. secretus sp. nov.

b^2. Marginal setæ at least often frayed or cleft before apex; anal plates with four to six large dorsal setæ close to apex of each; anal ring with eight to ten setæ.

c^1. Marginal setæ distinctly frayed in most cases; with a distinct cluster of heavy simple disk pores anterior to anal plates dorsally; anal ring apparently with eight setæ.
C. macarangæ sp. nov.

c^2. Marginal setæ rarely frayed, then usually unequally cleft near apex; without a distinct cluster of heavy, simple disk pores anterior to anal plates, but with a few, scattered; anal ring with ten setæ..... C. circularis sp. nov.

Genus **PLATYLECANIUM** Cockerell and Robinson

Platylecanium asymmetricum sp. nov. Plate 1, fig. 7.

Adult female.—Occurring on the under surface of the leaves of the host; length, 4 to 4.5 millimeters; width, 1.5 to 2; elongate, narrowed at each end, flat, dark reddish brown, sometimes almost blackish in the dried specimens, with more or less black mottling, probably due to the drying of the internal organs; eye spots pale, surrounded by a blackish area; all specimens prominently asymmetrical, with either the left or the right margin nearly straight and the opposite side broadly rounded; with slight incisions opposite the spiracles; fading out to yellow or reddish brown when boiled in caustic potash, the discal area darker; cleared derm showing numerous faint areolations, especially in the caudal region and dorsally pores of two sizes, the larger of these scattered over the surface, particularly near the margins and in about six irregular rows extending across the body between the eyespots and the anal plates, the smaller pores occurring mostly in irregular groups on each side and cephalad of the

anal plates, in a semicircular arrangement, three groups on each side of the plates, these the "cribriform plates" of the describers of the genus, most of the larger pores apparently with a flexible extrusible portion with a small seta at the apex; body margin unevenly crenulate, a narrow strip more heavily chitinized; antennæ small, of the rudimentary type, indistinctly 2-segmented, with faint traces of a third segment occurring as a narrow chitinized strip at the base of each antenna, this bearing a long, slender seta, the apical segment with five or six setæ; the whole antennæ about 54 to 57 μ long; legs apparently wholly wanting; spiracles small, shank slender, outer end widely expanded, inner end less so; marginal setæ slender, hairlike, scattered, apparently occurring in groups of twos or threes, with relatively long intervals between the groups; spiracular spines stout, not tapering, apices rounded, somewhat longer than the marginal setæ, placed in a deep closed incision in the body margin; dorsal surface setæ apparently confined to those mentioned in connection with the pores; ventral setæ not observed; with a single row of minute, quinquelocular disk gland pores running from each spiracle to the corresponding group of spines, and with a few, similar, but much larger pores with more loculi, ventrally in the anal plate region; no other gland pores noted; anal plates triangular, together diamond-shaped, length about 190 to 203 μ; width of each, about 71 μ; the anterolateral and posterolateral margins about equal in length; normally with an apical and three dorsal setæ close to the posterior end of each plate, with four or five ventral setæ on each and with one fringe seta on each side, all of these minute; anal plates with two or three minute dorsal pores near and posterior to the middle of each; anal ring small, thick, approximately circular, with six relatively long and prominent setæ, these somewhat swollen just before the base, the longest about 268 μ.

Young larva.—Elongate oval, more narrowed anteriorly, nearly 0.5 millimeter long and 0.22 wide; yellowish brown before treating with caustic potash; antennæ 6-segmented, the last longest, the third nearly as long, average lengths of these (in microns): II, 14; III, 43; IV, 16; V, 10; VI, 53; total length of legs about a fourth greater than that of antennæ; with a few, widely separated, tiny marginal setæ; with a single, relatively stout, spiracular spine set in a heavily chitinized incision in the body margin opposite each spiracle; with four or five minute multilocular disk pores between each spiracle and its spine; no other ducts or pores noted; anal plates proportionately more elongate

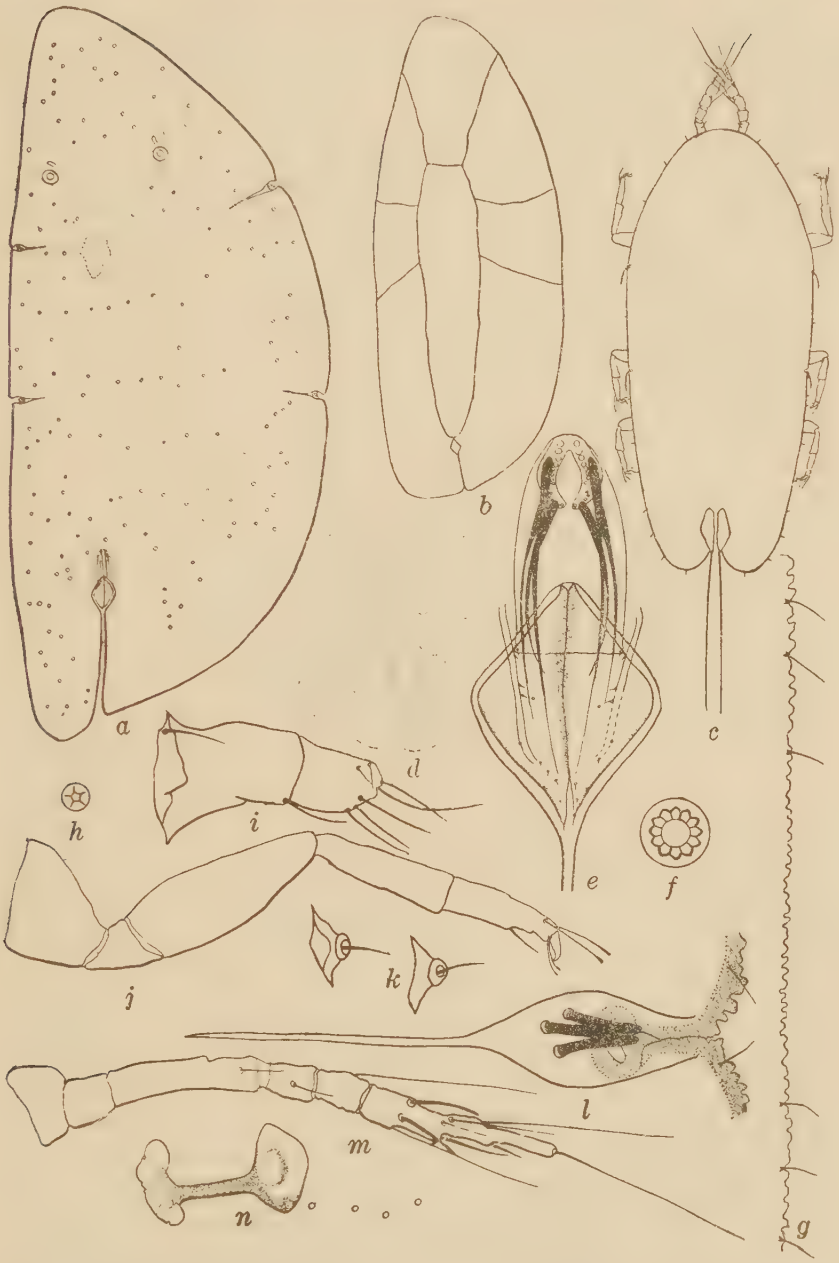

FIG. 11. *Platylecanium asymmetricum* sp. nov.; *a*, adult female, outline of body, showing shape, arrangement of large pores, etc., × 17.5; *b*, male puparium, × 30; *c*, larva, outline, × 165; *d*, adult female, dermal areolations, × 335; *e*, adult female, anal plates, × 165; *f*, adult female, pore from beneath anal plates, × 1,500; *g*, adult female, body margin, × 335; *h*, adult female, spiracular pore, × 1,500; *i*, adult female, antenna, × 640; *j*, larva, leg, × 640; *k*, adult female, dorsal setæ, × 640; *l*, adult female, spiracular spines, × 335; *m*, larva, antenna, × 640; *n*, adult female, spiracle, × 640.

and slenderer than in adult, broadly rounded anteriorly, acutely pointed posteriorly, terminating in a long seta measuring about 182 μ, the plates themselves about 53 μ long; anal ring apparently with only four rather long setæ, this not definitely determinable.

Male puparium.—Of thin transparent wax, also slightly asymmetrical, about 2.25 millimeters long and 0.9 wide, flat dorsally, with a pair of longitudinal lines running cephalad from the anal plate region close together and diverging near the cephalic end of the body after being united by a single transverse line; with a pair of transverse lines running to the body margin on each side, posterior to the median transverse line.

This species has been described from seven specimens mounted on slides, and about twenty-five specimens on or detached from the host, all from the undersides of the leaves of *Pinanga*, Government Hill, Singapore, August, 1917, collected by I. H. Burkill (*Baker 8942*). The types are in the United States National collection of Coccidæ.

The conspicuously asymmetrical character of all the stages of this species, except the young larva, is quite probably due to the method of attachment of the insect close to one of the deep, but narrow, riblike veins of the host leaf, but this characteristic is constant and pronounced in every specimen examined.

Three species are now known to belong in the genus *Platylecanium*—the type, *P. cribrigerum* (Cockerell and Robinson), *P. pseudexpansum* (Green), and the species just described; all agree in being flat with a very thin film of dorsal secretion, in having reduced antennæ, no legs, marginal setæ minute, simple, well separated, spiracular spines cylindrical or slightly tapering, in groups of three, set in deep incisions opposite each spiracle, diamond-shaped anal plates bearing minute setæ, anal ring with six setæ and a dorsal semicircular row of "cribriform plates," three on each side of the anal plates. The most-nearly related genus known to me is *Paralecanium* Cockerell, which is definitely differentiated from the genus under discussion only by the modification of the marginal setæ to form broadly expanded and flattened, closely set, usually circular or oval, striate flabellæ. The more conspicuous differences between the adult females of the three species included in *Platylecanium* are indicated in the following key. This cannot be considered final, on account of lack of specimens of the genotype, only a small portion of one specimen being available for examination, and indeed it is possible that the new species described here is actually *cribrigerum* (Cockerell and Robinson), and that the

differences which can be observed between the two are to be traced directly to the possible modification of shape resulting from the specimens settling in a position so close to the veins of the host.

Key to the species of Platylecanium Cockerell and Robinson.

a^1. Antennæ reduced, but plainly 4- to 6-segmented; derm clearing almost completely on treating with caustic potash; light brown; broad oval, nearly circular..... **P. pseudexpansum** (Green).

a^2. Antennæ much reduced, at most indistinctly 2-segmented; derm remaining translucent brown after treating with caustic potash; normal color dark reddish to blackish brown.

b^1. Broad oval, approaching circular in outline; antennæ 1-segmented. **P. cribrigerum** (Cockerell and Robinson).

b^2. Elongate, asymmetrical, one side nearly straight, ends pointed; antennæ indistinctly 2-segmented..... **P. asymmetricum sp. nov.**

Genus PARALECANIUM Cockerell

With one or two exceptions, the species of the genus *Paralecanium* now known form a compact, closely related group within which specific differentiation is quite difficult, particularly where only limited material in uncertain condition is available. On this account the two species which follow have been described with considerable reluctance, particularly the second one, where it has not been possible definitely to determine the nature of some of the structural characters.

Paralecanium ovatum sp. nov.

Adult female.—Occurring on both sides of the leaves of the host, but mostly on the upper surface; flat, broad oval; maximum length, 2.6 millimeters; width, 2; dark reddish brown, with a very thin, transparent coating of wax, and with two indistinctly marked rows of dorsal quadrate areas on each side of the middle line; some younger specimens showing a light submarginal zone similar to that described for *P. zonatum* (Green), and lighter brown in color; clearing only slightly after boiling in caustic potash, the older specimens remaining dark reddish brown; the ventral marginal zone narrow, width much less than half the length of anal cleft, slightly recurrent along this cleft; dorsal quadrate areas somewhat more distinct after boiling; central disk of the dorsum with only an occasional pore, outer two-thirds all the way around the body with numerous, obscure, oval or round areolations, and with an occasional clear pore; with a very poorly defined row of clear pores, usually in pairs, curving outward and forward on each side of the anal plates, these corresponding to the well-defined "cribriform plates"

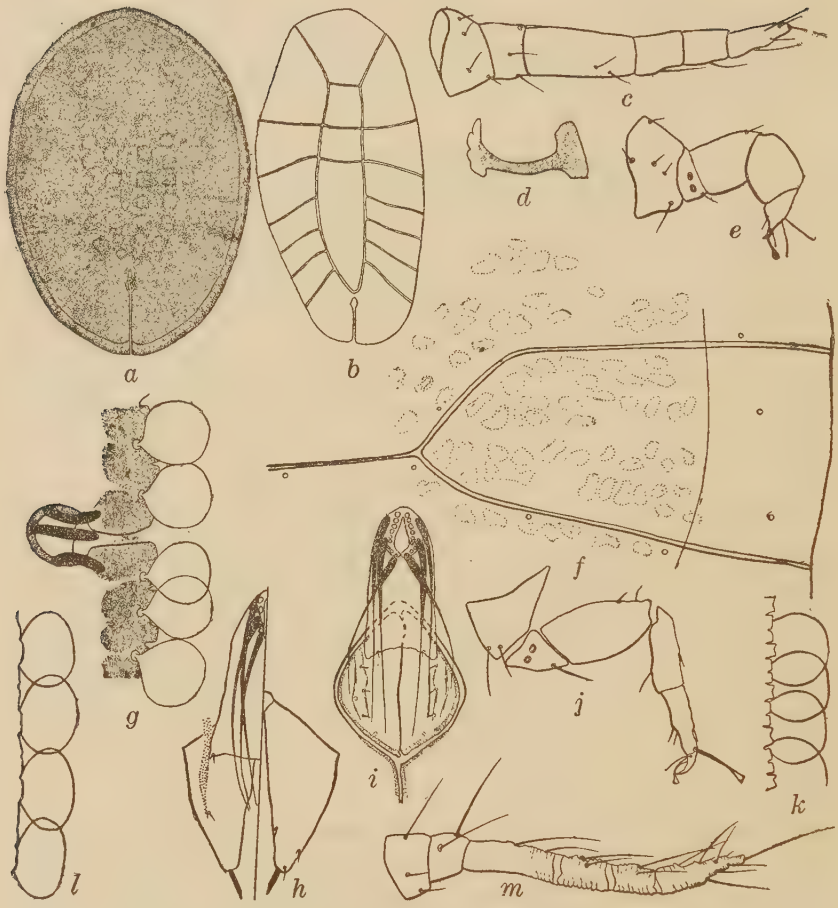

FIG. 12. *Paralecanium ovatum* sp. nov.; *a*, adult female, outline, × 16.5; *b*, male puparium, × 30; *c*, adult female, antenna, × 335; *d*, larva, spiracle, × 335; *e*, adult female, leg, × 335; *f*, adult female, section of body margin showing areolation, etc., × 165; *g*, adult female, spiracular spines, × 335; *h*, larva, anal plates, × 440; *i*, adult female, anal plates, × 165; *j*, larva, leg, × 335; *k*, marginal flabellæ of younger adult female, × 335; *l*, same, of older adult female, × 335; *m*, larva, antenna, × 335.

found in some other species; marginal third or a little more of the dorsum divided into large plates by thin transparent lines through the derm, the resulting arrangement at the margin somewhat similar to that found in *Eucalymnatus tessellatus;* antennæ small, 6-segmented, average lengths of the segments about as follows (in microns): I, 18; II, 14; III, 46.5; IV, 18; V, 17; VI, 27; the third segment nearly twice as long as any other; antennæ sometimes even more reduced than indicated by the preceding measurements, and some of the joints indistinct or apparently wanting; legs present, but much reduced, approach-

ing the rudimentary type; spiracles small, with slender shank and expanded ends; marginal flabellæ fan-shaped, large, broadly expanded, roughly circular in outline, widest at or a little beyond the middle, the edge entire, faintly striate, the striæ diverging from base; in older individuals the flabellæ usually distinctly wider than long and widest about the middle, overlapping more or less, this varying from adjacent flabellæ only slightly, overlapping to alternate flabellæ nearly meeting across the intervening one; spiracular spines three to a group, stout, but not very large, each group set in a distinct chitinized incision of the margin, all three approximately equal in size; body margin with tiny incisions between the insertions of the flabellæ, usually with only a single incision, making two lobules, sometimes with two incisions and three lobules, this arrangement inconspicuous, and sometimes obliterated in the older, mature individuals; with an occasional minute dorsal seta at least near the margin; no differentiated ducts or pores observed on the dorsum; ventrally with a single row of quinquelocular pores running from each spiracle to its corresponding spines, and with some similar, but larger, pores with more loculi around the anal plates; anal plates small, each about 125 μ long by 46 μ wide, set at the apex of a short cleft with contiguous sides; each plate sharply angulate anteriorly and posteriorly, the outer angle rounded off, widest at or a little behind the middle, the posterolateral margin faintly crenulate; perhaps with two very minute subapical setæ dorsally, apparently with three ventral setæ and a single fringe seta on each side, all these minute; with two minute dorsal pores on each plate at and posterior to the middle; anal ring small, normally placed well anterior to the anal plates, the setæ longer than the plates, curved and noticeably expanded at base, six in number.

Larva.—Elongate oval, about 0.63 millimeter long by 0.32 wide; antennæ 6-segmented, fairly well developed, average measurements as follows (in microns): I, 14; II, 13.5; III, 35.7; IV, 21.4; V, 17.8; VI, 35.7; legs fairly well developed; the lengths of a middle leg, coxa, 29 μ; trochanter and femur, 64 μ; tibia, 35 μ; tarsus, 32 μ; tibiotarsal articulation indistinct; marginal setæ slender, hairlike, in no way resembling the flabellæ of the adult; spiracular spines set in a chitinous incision of the margin, three in number, the intermediate the largest; anal plates elongate, slender, rounded anteriorly, sharply pointed posteriorly, about 50 μ long, with an apical seta about 46 μ long.

Second-stage female.—About twice as large as the larva, somewhat broader, with the legs and antennæ much reduced as in the adult, the apical seta of anal lobes reduced in size, the marginal setæ widely separated and still hairlike.

Male puparium.—Apparently characteristic of the genus as described and figured for other species; see figure.

This species has been described from seven specimens mounted on slides and from a few additional specimens on the host. The material was collected on *Pandanus* sp. at the Botanic Gardens, Singapore, October, 1917 (*Baker 9029*). The types are in the United States National collection of Coccidæ.

This species appears to differ from the other described species of the genus most conspicuously in having the legs and antennæ present, but semirudimentary. Disregarding this difference, the species would run to the pair *zonatum* and *maritimum* in Green's key to the Ceylon species of the genus,[4] and from these two it appears to be separable by the distinctly greater width of the anal plates in proportion to their length, and by having the anterolateral margin of each of these at least slightly longer than the posterolateral.

Paralecanium vacuum sp. nov. Plate 1, fig. 8.

Adult female.—Occurring on the upper surface of the leaves of the host; very faintly convex, nearly circular, somewhat broadened behind; length, about 10 milimeters; width, about 9; margin not or only slightly sinuate opposite the spiracles and at the anal cleft; light brown, varying and variegated, the median area with numerous irregular blackish blotches, apparently produced by the discoloration of the dried internal organs; marginal area irregularly areolate with lighter streaks, with most of the extreme edge light; all this not constant; coated dorsally with a relatively thick, rather brittle, detachable layer of nearly transparent wax, this densely and minutely areolate, and showing near the margin radial rows of tiny holes corresponding in position to small conical elevations of the underlying derm, these bearing small setæ, showing also clusters of similar holes corresponding to the group pores, arranged in a semicircle on each side of the anal plates, and finally six very faint and slightly depressed longitudinal rows of quadrate areas of the sort usually found in the genus; derm clearing almost completely on treating with caustic potash, but showing numerous faint areolations, these scattered or irregularly grouped in the central

[4] Coccidae of Ceylon, pt. 3 (1904) 185.

area, but very closely crowded along the margin, although interrupted at intervals here by solid radial clear streaks, each bearing a few tiny setæ; with some additional small setæ, widely scattered, dorsally; antennæ probably, but not certainly, present, development not known; legs probably, but not certainly, wanting; spiracles and mouthparts not observed; dorsally with eight clusters of pores and small cicatrices, arranged in a semicircle, four on each side of the anal plates, the rows curving forward; no other specialized dorsal gland pores observed; ventrally with small quinquelocular pores between spiracles and margin, no others noted, probably due to condition of specimens; dorsally

FIG. 13. *Paralecanium vacuum* sp. nov., adult female; *a*, portion of derm at margin, showing flabellæ and areolation, × 57.5; *b*, detail of body margin and flabellæ, × 220; *c*, anal plates, × 115; *d*, number and position of "cribriform plates," × 12, with detail of one plate, × 220, and detail of single pore from plate, × 1,500; *e*, spiracular spine incision, showing bases of spines, × 500; *f*, spiracular disk pore, × 1,500; *g*, dorsal seta, × 1,500.

with the small, stiff, scattered setæ already mentioned; spiracular spines in threes, but all broken, so the size and shape indeterminate; marginal flabellæ small as compared with the total size of the insect, broader than long, but varying to some extent, nearly sessile, normally slightly overlapping; no ventral setæ observable, due to condition of specimens; marginal interspaces between insertions of flabellæ very indefinitely incised, with from three to six visible incisions at some points, these indistinct at others, and with only minute crenulations showing; anal plates

long triangular, each more than twice as long as wide, all the angles rather sharp, the posterior and anterior acute, dorsally at or close to the apex of each with four small, stiff setæ, ventral ridge with one larger seta at base and another, still larger, at apex, with five fringe setæ on each side; no hypopygial setæ; anal ring placed anterior to the plates, small, with pores and six relatively large, stout setæ.

This species has been described from a few broken specimens received from Mr. E. E. Green with the following information: "On *Ficus* sp., Singapore, coll. *I. H. Burkill.*" The name assigned to it here is the manuscript one given to the species by Mr. Green. The types are in the United States National collection of Coccidæ.

This species has been very reluctantly described, as no whole specimen has been available for study, and such broken pieces as have been mounted fail to show some characters satisfactorily.[5] The species is the largest one described in the genus, a possible factor in its recognition, and in all the material examined fails to exhibit the ventral, marginal, chitinous zone usually present in the species of this genus.

[5] As a result of informing Mr. Green of the incompleteness of the preceding description, he has supplied the following descriptive notes from specimens in his possession, the quotation of which almost in toto seems desirable:

"Adult female broadly oval, usually symmetrical, sometimes slightly asymmetrical; almost flat, very slightly convex above; below with a shallow cavity on each side of abdomen, forming a receptacle for the ova or young larvae. Colour dull pale castaneous, or brownish ochreous. After treatment with clearing reagents, the insect appears unusually featureless, owing to the complete absence of limbs and the rudimentary condition of the antennae. Rostral apparatus small and inconspicuous. A pair of circular vacuoles (each with an approximate diameter of 0.25 mm.) at a distance of 1 mm. within the margin, represent eye spots. Antennae 0.15 mm. long; with from four to five confused segments; a few short stout setae upon the apical point. Valves of anal operculum with acute apices; narrow; outer angle rounded; basal margin equal to outer margin. Two scattered series of beaded pores on each side of anal aperture. Stigmatic clefts extending to a distance of 0.25 mm. within the margin; terminating in a semilunar chitinous plate bearing three to five stout club-shaped spines. Spiracle at a distance of 2 mm. from the base of each stigmatic cleft. Length of anal cleft approximately 2 mm. Length of complete insect, 10 mm.; breadth, 8.5 mm. Very near *expansum* Green (which see). Differing in little but its extreme size. It is a question if it should rank as more than a variety or subspecies."

ILLUSTRATIONS

PLATE 1

FIG. 1. *Anomalococcus multipori* sp. nov.; actual length, about 2 millimeters.
2. *Alecanium hirsutum* gen. et sp. nov.; actual length, about 1.75 millimeters.
3. *Coccus tumuliferus* sp. nov.; actual length, about 2 millimeters.
4. *Coccus caviramicolus* sp. nov.; actual length, about 2.5 millimeters.
5. *Coccus macarangæ* sp. nov.; actual length, about 3.25 millimeters.
6. *Coccus circularis* sp. nov.; actual length, about 3 millimeters.
7. *Platylecanium asymmetricum* sp. nov.; actual length, about 4.5 millimeters.
8. *Paralecanium vacuum* sp. nov.; actual length, about 10 millimeters.

TEXT FIGURES

FIG. 1. *Paleococcus pulcher* Leonardi.
2. *Anomalococcus multipori* sp. nov.
3. *Pseudococcus hispidus* sp. nov.
4. *Alecanium hirsutum* gen. et sp. nov.
5. *Coccus tumuliferus* sp. nov.
6. *Coccus penangensis* sp. nov.
7. *Coccus caviramicolus* sp. nov.
8. *Coccus secretus* sp. nov.
9. *Coccus macarangæ* sp. nov.
10. *Coccus circularis* sp. nov.
11. *Platylecanium asymmetricum* sp. nov.
12. *Paralecanium ovatum* sp. nov.
13. *Paralecanium vacuum* sp. nov.

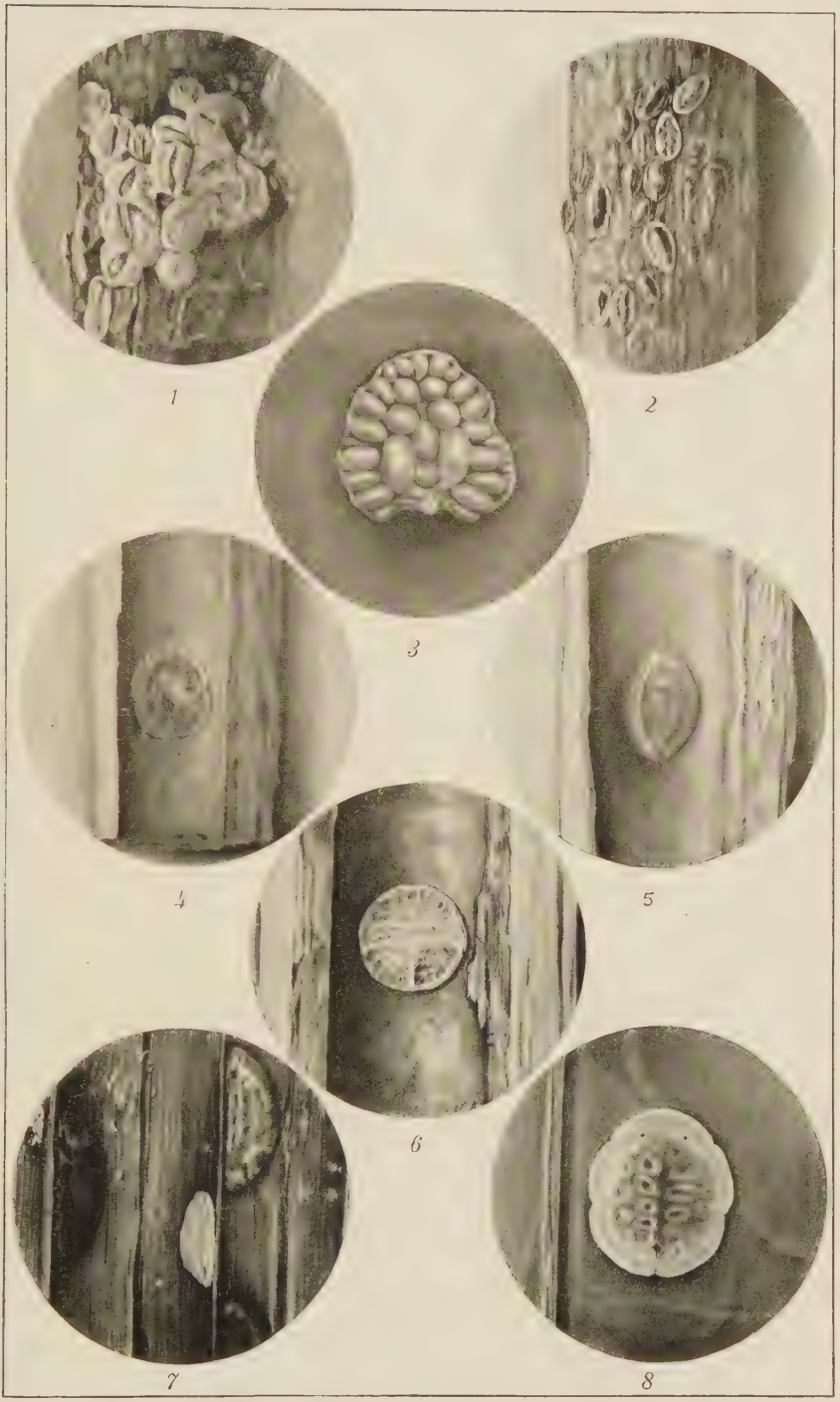

PLATE 1. NEW COCCIDS.

NEW GENERA AND SPECIES OF PHILIPPINE MEMBRACIDÆ

By W. D. FUNKHOUSER

Of the Zoölogical Laboratory of the University of Kentucky

ONE PLATE

Recent collecting by Prof. C. F. Baker, of Los Baños, in some of the hitherto unexplored parts of the Philippine Islands has yielded new species of Membracidæ so remarkable in appearance that it seems desirable to give them a place in the literature of the family as soon as possible after their discovery.

Six of these new species are here described, two of which are so peculiar in character as to demand new genera for their accommodation.

All of these insects were collected by Professor Baker, to whom I am greatly indebted for the privilege of studying much interesting Philippine material.

Genus **CLONAUCHENIA** novum

Near *Hypsauchenia* Germ., but differing greatly in the shape and position of the pronotal elevation which is laterally branched.

Scutellum present but entirely concealed by the pronotum; tibiæ foliaceous; sides of thorax extended to form two small teeth; tegmina largely coriaceous and almost entirely opaque, venation very irregular; hind wings with four apical areas; anterior process of pronotum widely, horizontally extended at top to form a heavy trilobed expansion; posterior process elevated to form a high, flattened, foliaceous plate, the tip extending almost to the anterior process; head foliaceous; clypeus strongly trilobed.

This genus may be separated at once from the genera *Hypsauchenia* Germ., *Pyrgonota* Stål, *Pyrgauchenia* Bredd., *Pyrgolyrium* Bredd., and *Pyrgophyllium* Bredd., all of which are closely related, by the remarkable development of the anterior process, which is so greatly modified at the distal end that it forms a central bulbous lobe with a heavy swollen horn on each side.

The genus is erected for the accommodation of the following species which is proposed as the type:

Clonauchenia mirabilis sp. nov. Plate 1, figs. 1 and 2.

Dark brown, roughly sculptured, coarsely punctate, sparingly pubescent; head trilobed; anterior pronotal process elevated, widely expanded above to form a heavy, trilobed, transverse branch, the outer lobes of which are modified to form swollen horns; posterior process elevated to form a flattened subtriangular plate which reaches almost to the middle lobe of the anterior process; tegmina opaque and coriaceous; mesothorax and metathorax covered with white tomentose pubescence; legs foliaceous.

Head dark brown, finely punctate, sparsely pubescent, irregularly sculptured, longer than wide, subtriangular; base irregularly rounded; eyes very dark brown; ocelli large, prominent, pearly, glistening, much farther from each other than from the eyes and situated well above an imaginary line drawn through centers of eyes; margins of genæ sinuate and produced; clypeus longer than wide, strongly trilobed, tip pilose.

Pronotum dark brown, irregularly sculptured with anastomosing ridges, coarsely punctate, not pubescent except on sides of anterior process which are slightly white tomentose; metopidium convex; median carina irregularly prominent; anterior pronotal process rising as a column above the head and spreading out at the tip to form a swollen transverse expansion, this expansion roughly trilobed, the central lobe more or less globular, the lateral lobes projecting outward to form heavy swollen nodular horns with ends suddenly acute; posterior process elevated to form a high, laterally compressed plate, which is roughly triangular in shape, the anterior margin concave, the posterior margin twice as long as the anterior and convex, the tip sharp and almost reaching the posterior margin of the middle lobe of the anterior process; the opening between the anterior and posterior processes smoothly ovate as seen from a side view; posterior process in type specimen broken at tip but extending beyond internal angles of tegmina.

Tegmina long and narrow, dark brown, base and two-thirds of costal margin opaque, coriaceous and strongly punctate, distal half semiopaque; tips diagonally truncate; venation irregular, in type specimen five apical and five discoidal cells. Hind wings with four apical cells.

Scutellum entirely concealed by the pronotum. Sides of mesothorax and metathorax covered with white tomentose pubescence which extends in a faint irregular area up the pronotum behind the eye and almost to the top of the anterior process; lower mar-

gins of mesothorax and metathorax extended to form rough toothlike projections.

Legs moderately foliaceous and flattened; finely pilose and closely spined; lighter in color than the rest of the body; tarsi ferruginous and finely pilose; claws flavous.

Undersurface of body very dark brown with white tomentose hairs on undersurface of abdomen.

Length to tips of tegmina, 8 millimeters; width between humeral angles, 2.6; maximum width of anterior process, 6.8; height of anterior process above head, 5.5.

Type, a male, in Professor Baker's collection.

MINDANAO, Surigao (*Baker*).

In sending me this specimen, Professor Baker writes:

> I am sending a single unique specimen of the *most remarkable* of Philippine Membracidae. It is very strange that it should have taken eight years of collecting to produce this one specimen. It only indicates that of the great fauna of the *high forests* we yet know but little.

It is certainly a remarkable insect and the specific name was naturally suggested.

Genus **MESOCENTRUS** novum

Near *Cryptaspidia* Stål but differing in having four apical cells in the hind wing and in having a high central elevation of the pronotum, suggesting the genus *Telamona* of the subfamily Smiliinæ.

Tibiæ simple; hind trochanters unarmed; hind wings with four apical areas; tegmina with five apical and three discoidal areas; scutellum present but entirely concealed by the pronotum; suprahumeral horns absent; dorsal crest simple, erect, without branches or extensions of any kind; posterior process heavy, curved, the tip bearing a sharp, narrow, carinate projection on the undersurface; head subquadrate; clypeus simple.

I have never seen a specimen of Melichar's genus *Monocentrus*[1] to which this genus is apparently closely related, but according to the description the insects belonging to *Monocentrus* have the pronotal crest branched and the posterior process angular as in *Anchon* Buckton.

Mesocentrus pyramidatus sp. nov. Plate 1, figs. 3 and 4.

Very dark brown with golden pubescence; pronotal crest arising in a pyramid above the humeral angles, this pyramid flat-

[1] Wien. ent. Zeit. (1905) 297.

tened laterally and nearly triangular as seen from a side view; no suprahumeral horns; posterior process heavy, curved, carinate above, tip compressed below into a sharp keel, just reaching internal angles of tegmina; tegmina black, punctate, pubescent and coriaceous at base, bronze and coriaceous from base as far as apical end of posterior process, apical end fuscous hyaline; legs and undersurface of body uniform brown.

Head subquadrangular, broader than long, very dark brown, roughly sculptured, finely punctate, sparingly pubescent with long golden hairs; base strongly sinuate, raised above ocelli; eyes large, brown, prominent; ocelli small, pearly, inconspicuous, farther from each other than from the eyes and situated well above a line drawn through centers of eyes; genæ curved, edges produced forward in a slight flange; clypeus broad, extending for half its length below the lateral margins of the genæ, tip semicircular, strongly pilose; antennæ slender and black.

Pronotum very dark brown, covered with dense golden pubescence, finely punctate, single pronotal crest raised in a laterally compressed elevation on median dorsal line, this elevation not quite as high as its width at base, nearly triangular, tip rounded and blunt, center of crest slightly posterior to humeral angles, both front and back margins sloping but front margin more declivous; humeral angles broad, heavy, blunt; no suprahumeral horns; metopidium strongly convex at median line; median carina percurrent, only faintly indicated on metopidium but very sharp on posterior process; scutellum present but entirely concealed by pronotum; posterior process heavy, impinging on tegmina, curved, blunt, strongly carinate above and extended below at tip to form a narrow bladelike keel, tip just reaching the internal angles of tegmina.

Tegmina narrow, pointed; base black, punctate, and coriaceous, this portion extending farther along the costal than the internal margin; the area extending from this black coriaceous portion to a point as far caudad as the apex of the posterior process is shining dark brown and more or less opaque and ends in a rather definite margin; the apical portion of the tegmina is hyaline with the tip slightly tinged with fuscous; veins prominent and strongly pilose; free margin beyond veins narrow and slightly wrinkled; five apical and three discoidal areas.

Undersurface of body entirely brown with dense golden pubescence which changes to a silvery tinge on the undersurface of the abdomen.

Legs simple, very dark brown, strongly pilose.

Length from front of head to tips of tegmina, 7 millimeters; width between humeral angles, 3.3; height from top of head to tip of crest, 2.6.

Type, a female, in Professor Baker's collection.

MINDANAO, Iligan (*Baker*).

Emphusis globosus sp. nov. Plate 1, figs. 5 and 6.

Near *E. obesus* Fairm., but differing in the formation of the pronotal elevation.

Very dark purplish brown, irregularly sculptured and coarsely punctate; white tomentose pubescence on sides of pronotum under suprahumeral horns and on mesothorax; pronotal elevation very large, nearly globular; suprahumeral horns short, blunt, continuing line of metopidium; posterior process heavy, impinging on tegmina; tegmina bronze translucent except along basal costal border which is coriaceous and punctate.

Head subtriangular, longer than wide, roughly sculptured, finely punctate, brown; base sinuate; eyes large, brown; ocelli conspicuous, amber-colored, shining, farther from each other than from the eyes and situated slightly above a line drawn through centers of eyes; a prominent longitudinal ridge just inside each ocellus; genæ extended strongly cephalad in a sinuate flange; clypeus longer than wide, strongly trilobed, outer lobes continuing line of margins of genæ, concolorous with the rest of the head, finely punctate, sparingly pilose.

Pronotum extended upward in a large globular swelling above the head, dark purplish brown, irregularly sculptured with anastomosing lines, coarsely punctate with deep irregularly shaped punctures; metopidium extremely convex, narrow at base and suddenly expanding to form a globe above; median carina strongly percurrent from head to extremity of posterior process; lateral angles large, prominent, blunt; suprahumeral horns very heavy, thick, wide, blunt, continuing curve of metopidium, extending outward and backward and very slightly downward; base of pronotum below horns on each side thickly covered with a white tomentose patch which extends downward over the mesothorax and metathorax behind the eye; posterior process thick and heavy, tip broken in type specimen but undoubtedly reaching beyond the internal angles of the tegmina on which it impinges.

Tegmina long, narrow, blunt, bronze-colored, wrinkled, subtranslucent or subcoriaceous except at base and basal costal area which is punctate, entirely coriaceous and opaque; marginal area beyond veins narrow; five apical and three discoidal areas. Hind wings hyaline; four apical areas.

Legs and undersurface of body uniform brown; tibiæ subquadrate, pilose; tarsi somewhat lighter in color, pubescent.

Length from front of head to tips of tegmina, 7 millimeters; height of pronotal elevation above head, 5; width between tips of suprahumeral horns, 5.

Type, a male, in Professor Baker's collection.

MINDANAO, Dapitan (*Baker*).

Pyrgonota noditurris sp. nov. Plate 1, fig. 7.

Entirely luteous, coarsely punctate, very sparingly pubescent; anterior horn long, nearly straight, swollen at tip and strongly nodose on posterior margin; posterior process long, sinuate, gradually acuminate, extending beyond internal angles of tegmina, toothed on dorsal ridge; tegmina wrinkled, hyaline, punctate on basal half; legs strongly foliate; undersurface of body entirely luteous.

Head subquadrate, finely punctate, yellow, tinged with red, convex; base bluntly angulate; eyes small, black; ocelli very small, white, not conspicuous, about equidistant from each other and from the eyes and situated slightly above a line drawn through center of eyes; clypeus very large, strongly trilobate, extending for more than half its length below anterior margins of genæ, tip pilose.

Pronotum luteous, slightly tinged with darker on posterior margin of anterior horn; anterior horn extending upward and forward, longer than the body, strongly and coarsely punctate, two prominent swellings on posterior margin below tip, tip swollen, rounded, marked into irregular areas by ridges, sides of horn very slightly tricarinate below tip; metopidium nearly straight; humeral angles not prominent; a deep depression between eye and humeral angle; posterior process luteous, tinged with red at tip, sinuate, strongly toothed on dorsal margin, gradually acuminate, extending to a point about midway between internal angles and tips of tegmina.

Tegmina luteous hyaline, wrinkled, angular, basal half strongly punctate and somewhat coriaceous, tips pointed, venation at tips very irregular. Undersurface of body entirely luteous, lightly pubescent; legs strongly foliaceous, entirely clay yellow except claws which are brown.

Length from front of head to tips of tegmina, 5.6 millimeters; length of anterior horn from top of head, 6; width between humeral angles, 2.

Type, a female, in Professor Baker's collection.

MINDANAO, Surigao (*Baker*).

Leptobelus elevatus sp. nov. Plate 1, figs. 8 and 9.

Black, shining, punctate, partly pubescent; pronotal elevation very high, branching at top into two long, sharp, lateral horns; posterior process long, slender, decurved, arising well below bases of lateral horns and extending beyond internal angles of tegmina; scutellum entirely exposed, much longer than wide, gradually acuminate; tegmina bronze hyaline with black punctate base and brown veins; undersurface of body dark brown; legs black; tarsi flavous.

Head subquadrangular, wider than long, convex, black, shining, faintly longitudinally striate, lightly punctate, base strongly convex; eyes large, brown, mottled with flavous; ocelli small, pearly, farther from each other than from the eyes and situated well above an imaginary line drawn through centers of eyes; clypeus smooth, black, shining, flat, neither pubescent nor punctate, more or less trilobed at apex, extending for more than half its length below the apical margins of the genæ.

Pronotum black, very coarsely punctate, shining, without pubescence in front but lightly pubescent behind, rising in a cone-shaped turret above the humeral angles to a height equal to its width and then extending upward and slightly forward as a roughly cylindrical process from which is given off the posterior process at about its middle and two long, sharp, lateral horns at its extremity; lateral horns sharp, irregularly quadricarinate, extending almost directly outward, very slightly downward and with tips bent slightly backward, each horn about as long as the maximum width of the metopidium; posterior process long, slender, sharp, almost uniform in thickness throughout its length, sharply and distinctly quadricarinate, very highly elevated above the body and extending to a point about one-third the distance from the internal angles to the tips of the tegmina; humeral angles small, blunt, not prominent; metopidium convex, higher than wide; scutellum entirely exposed, longer than wide, gradually acuminate, base densely pubescent, the pubescence extending upward on the pronotum to the base of the posterior process, tip very roughly punctate and slightly decurved; tegmina smoky hyaline, bases narrowly black, coriaceous and punctate, veins brown, tips extending beyond end of abdomen.

Undersurface of body very dark brown, almost black, sparingly pubescent, with short silvery hairs; legs black, femora smooth, tibiæ strongly spined, tarsi and claws flavous.

Length from front of head to tips of tegmina, 7.6 millimeters; width between humeral angles, 3; height of pronotal process from top of head, 3.8; distance between tips of lateral horns, 5.9.

Type, a female, in Professor Baker's collection.

PALAWAN, Puerto Princesa (*Baker*).

This species may be distinguished from any previously described species of the genus by the fact that the posterior process arises well below the lateral horns.

Cryptaspidia pilosa sp. nov. Plate 1, fig. 10.

Near *C. impressa* Stål but smaller and differs in having the metopidium without a keel, the head nearly flat, the tegmina without ferruginous fascia and the clypeus only feebly pubescent.

Black, shining, punctate, pilose; pronotum strongly convex in front, smooth on metopidium, carinate on posterior process; posterior process just reaching internal angles of tegmina; tegmina hyaline except at base which is black; veins of tegmina strongly pilose; undersurface of body black; femora dark brown or black; tibiæ and tarsi ferruginous.

Head much wider than long, nearly rectangular, only feebly convex between ocelli, strongly depressed between ocelli and eyes, finely punctate, closely pubescent, with short golden hairs, base sinuate; eyes large, prominent, luteous mottled with ferruginous; ocelli small, pearly, semitransparent, much farther from each other than from the eyes and situated well above an imaginary line drawn through centers of eyes; clypeus short, nearly triangular, apical margin rounded and almost continuing the lower margin of the genæ, finely punctate, feebly pubescent, with very short hairs.

Pronotum black, shining, regularly and strongly punctate, strongly pilose, with long golden hairs; metopidium wider than high, regularly rounded, not carinate, strongly pilose; lateral angles prominent, triangular, blunt, extending farther laterad than the outside margins of the eyes; posterior process short, depressed at base, gradually acuminate, tricarinate, strongly pilose, slightly deflexed at tip which just reaches internal angles of tegmina; tegmina hyaline, wrinkled, five apical and two discoidal areas, immaculate except at base which is black, punctate and pilose, the black coriaceous area extending for one-third the length of the tegmina along the costal margin but less than half that distance along the internal margin, this black area also being divided by a hyaline line through the center, veins brown,

those in center of tegmen being darkest and all strongly pilose, with long golden hairs; hind wings entirely hyaline.

Undersurface of head and thorax black; undersurface of abdomen dark brown with each abdominal segment margined posteriorly with a narrow band of sordid white.

Femora dark brown except at distal ends which are ferruginous; tibiæ ferruginous and densely pilose, those of the last pair of legs bearing small, sharp, black spines; tarsi ferruginous; claws brown.

Length from front of head to tips of tegmina, 4 millimeters; width between tips of humeral angles, 2.

The type specimen, a male, bears Professor Baker's duplicate No. 13879.

BASILAN (*Baker*).

It should be noted that the insects of the genus *Cryptaspidia*, in addition to being longer-bodied and slenderer than those of the genus *Gargara* to which they are closely allied, differ also in having the scutellum entirely concealed. They may be separated from the genus *Tricentrus* by the lack of suprahumeral horns, and from the genus *Centrotoscelus* by the absence of spines on the hind trochanters. The character of the two discoidal cells, considered by Stål as generic, does not always hold.

ILLUSTRATIONS

Plate 1

Fig. 1. *Clonauchenia mirabilis* sp. nov., lateral view.
2. *Clonauchenia mirabilis* sp. nov., frontal outline.
3. *Mesocentrus pyramidatus* sp. nov., lateral view.
4. *Mesocentrus pyramidatus* sp. nov., frontal outline.
5. *Emphusis globosus* sp. nov., lateral view.
6. *Emphusis globosus* sp. nov., frontal outline.
7. *Pyrgonota noditurris* sp. nov., lateral view.
8. *Leptobelus elevatus* sp. nov., lateral view.
9. *Leptobelus elevatus* sp. nov., frontal outline.
10. *Cryptaspidia pilosa* sp. nov., lateral view.

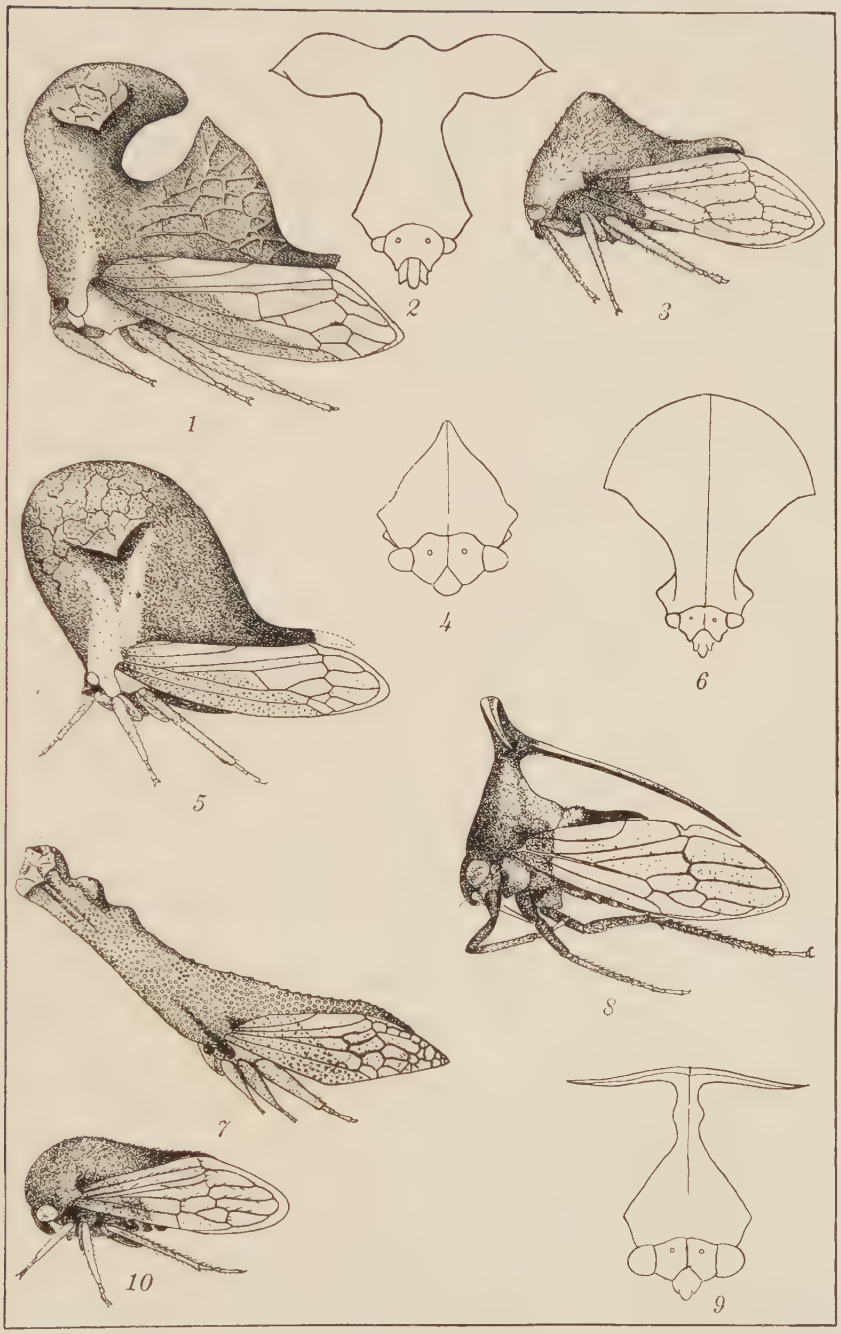

PLATE 1. PHILIPPINE MEMBRACIDÆ.

SOME PHILIPPINE WASPS OF THE FAMILY CHRYSIDIDÆ

By S. A. Rohwer

Honorary Custodian of Hymenoptera, United States National Museum

In some Philippine Hymenoptera received for identification from the Philippine Bureau of Agriculture was a new subspecies of *Stilbum cyanurum*. This new subspecies is described and some synonymy indicated in the present paper. In addition to this all the specimens of Philippine chrysidids in the collections of the United States National Museum are listed.

Ellampus (Holophris) bakeri Mocsáry.

A single female of this species was collected by C. R. Jones and is recorded under No. 1708, Bureau of Agriculture, P. I.

Hedychrum stantoni Ashmead.

The single male type from Manila, collected by W. A. Stanton.

Chrysis (Hexachrysis) comottii var. **igniceps** Mocsáry.

A single female under accession No. 1403, Bureau of Agriculture, P. I., collected by C. R. Jones.

Stilbum cyanurum var. **chrysocephalum** Buysson.

Stilbum splendidum var. *chrysocephalum* Buysson, Ann. Soc. Ent. France 66 (1897) 544.

Stilbum cyanurum var. *flammiceps* Mocsáry, Philip. Journ. Sci. § D 8 (1913) 288.

There is nothing in the original descriptions of these two varieties which would indicate that they are different, and I believe the above synonymy is correct.

Stilbum cyanurum subsp. **amethystinum** Fabricius.

Uniformly dark blue with purplish reflections. Specimens from the following localities: Luzon, Manila (*Robert Brown, C. V. Piper*); Bacoor (*P. L. Stangl,* November); San Rafael (*A. P. Ashby*).

Stilbum cyanurum subsp. **amethystinum** variety.

Uniformly blue-green except the third segment which is dark blue. Specimens from the following localities: Luzon, Manila

(*W. A. Stanton, M. B. Mitzmain,* January 22, 1911). PANAY, Culasi (*R. C. McGregor,* June, 1918). Accession Nos. 363, 826, Bureau of Agriculture, P. I.

Stilbum cyanurum subsp. **luzonensis** subsp. nov.

Female.—Length, 15 millimeters. Uniformly light green with strong coppery reflections; third tergite dark green; wings fuscous; mesoscutum sculptured as in *amethystinum;* produced portion of metanotum truncate posteriorly.

Type locality.—Philippine Islands.

Type.—Catalogue No. 23738, United States National Museum.

Described from one female (*C. R. Jones*), accession No. 1402, Bureau of Agriculture, P. I.

DESCRIPTION D'UN CANTHYDRUS (COLEOPTERA-DYTISCIDÆ) NOUVEAU, DES ILES PHILIPPINES

Par R. Peschet

Paris, France

Canthydrus bakeri sp. nov.

Forme assez convexe en avant, acuminée en arrière. Noir brillant, labre roux clair, partie antérieure de la tête ferrugineuse, angles antérieurs du pronotum largement, marge latérale étroitement ferrugineux. Elytres maculés d'une tache sublatérale rougeâtre, petite, située un peu en arrière du milieu, visiblement transverse et de forme un peu irréguliére.

Ponctuation nulle sur la tête et le prothorax, réduite sur les élytres à une série discale visible à la base, obsolète au sommet où elle est réduite à quelques petits points très espacés et très peu imprimés; série latérale presque nulle, à peine indiquée par quelques points superficiels à la base et au milieu de l'élytre.

Réticulation très fine, visible seulement sous un fort grossissement, simple, à mailles égales, rondes sur la tête, très légèrement transverses sur le prothorax, nettement et fortement transverses sur les élytres.

Dessous noir brillant; antennes, palpes, pattes, sommet et bords latéraux de l'apophyse coxale d'un roux ferrugineux rembruni sur les pattes posterieures.

Longueur: 2.8 á 3 millimètres.

Types: Luzon, Laguna, Los Baños (*Baker*), 3 individus.

Espèce extrémement voisine, à première vue, du *Canthydrus guttula* Aubé de Madagascar et d'Afrique tropicale, et confondue avec celle-ci par le Dr. M. Régimbart.[1] Elle en diffère par sa forme un peu moins convexe, par sa tache élytrale transverse (elle est ronde et plus grande chez *C. guttula* Aubè), et surtout par sa réticulation bien caractéristique. Celle-ci, chez *C. guttula* Aubé, est formée sur le pronotum de mailles très fortement transverses (plus de quatre fois plus larges que longues) dont les bords latéraux, plus imprimés, déterminent des lignes longitudinales flexueuses bien visibles. Enfin la ponctuation élytrale du *C. guttula* Aubé est beaucoup plus imprimée, la série latérale est

[1] Ann. Soc. Ent. France (1889) 247.

bien visible, prolongée avec la série discale jusqu'au sommet, où elles sont entremêlées de points épars assez nombreux et bien imprimés.

Ces caractères, très constants, permettent de différencier nettement ces deux espéces.

Distribution géographique.—Philippines: Los Baños (types); Nouvelle-Guinée: Rigo; Timor; Causip [2] (collection M. Régimbart, sous le nom de *Canthydrus guttula* Aubé); Laos: Xieng-Khouang; Vientiane; Son Hat (Vitalis de Salvaza).

[2] Cette localité de Causip est énigmatique et ne figure sur aucune carte: le Dr. M. Régimbart la situe avec doute dans les Philippines ou à Bornéo (voir *Hydrocoptus scapularis* Rég.).

POSITION AND SIZE OF THE KIDNEYS AMONG FILIPINOS [1]

By Juan C. Nañagas

Of the Department of Anatomy, College of Medicine and Surgery, University of the Philippines

THREE TEXT FIGURES

This preliminary report on the study of the position and the size of the kidneys among Filipinos is based upon measurements of forty-eight cases from the dissection laboratory of the department of anatomy, of which twenty-four were males and twenty-four females.

I am considering in this paper only the position and the measurements of the organ. The incompleteness of the work is principally due to the limitations attendant upon the dissection of cadavers and to the lack of facilities for studying the other renal conditions in fresh cadavers.

POSITION OF THE KIDNEYS

Some textbooks in anatomy and surgery would lead one to believe that the kidneys are invariably placed in a fixed position. This so-called "normal position," however, is in reality an indefinite condition. Its determination is beset with serious difficulties, for many are the factors which influence the variability of its location. Among the principal factors of influence we may mention:

Congenital lax condition or absence of renal fascia or peritoneal support (perinephric and paranephric fat).

Ptoses of neighboring visceræ, or any abnormal position of the surrounding organs.

Pregnancy, intra-abdominal tumors, accumulations of fluid or their disappearance, thereby producing laxity and weakness of the abdominal wall.

Atonicity of the posterior muscles of the abdomen, especially of those concerned with the formation of the renal fossa, occurring either locally or as part of the general weakness of the body musculature.

[1] Read before the Manila Medical Society, October 4, 1920.

Elongation of the renal vessels under such accidental conditions as jars, jolts, etc., caused by jumping, falling, coughing, tight lacing, etc., which tend to lengthen those vessels as well as to stretch the peritoneum.

Changes due to different postures assumed by the body and to respiratory movements.

In my determination of the renal position, I have used as points of reference the vertebral column for the horizontal planes of the renal poles and the mid-dorsal line of the body in relation to the vertical planes of the medial and lateral borders. I have not considered relations to any great extent because of the fact that the material in the hands of the students did not offer reliable fixed relations and, moreover, the relatively long period of time elapsing between death and embalmment made difficult a study of this part of the subject.

I deplore that more points of reference such as the iliac crest, ribs, umbilicus, etc., are not considered in this paper. To have considered these would have necessitated delays in the dissection work, which could not very well be afforded.

I was able to collect data relative to the levels of the renal poles in thirty-four cases, eighteen males and sixteen females.

In general I found the relative levels of the kidneys as follows:

	Cases.	Per cent.
Right kidney lower than left	27	79.4
Right kidney higher than left	4	11.7
Right and left kidneys at level	3	8.8

My detailed findings are recorded in Table 1 and illustrated by fig. 1, the latter adapted from Rauber-Kopsch,(4) from which we deduced the following:

UPPER POLES OF THE KIDNEYS

The upper right pole in males occupied a level varying from the upper third of the second lumbar vertebra to the middle of the eleventh dorsal, while that of the female was found from the disk between the first and second lumbar vertebræ to the disk between the eleventh and twelfth dorsal.

In the left side in males the kidney varied in level from the disk between the first and second lumbar vertebræ and the upper third of the eleventh dorsal, and in females it was found between the middle of the first lumbar vertebra and the lower third of the eleventh thoracic.

TABLE 1.—*Vertebral levels of the two kidneys in the two sexes.*

POSITION OF THE UPPPER POLE.

Vertebral level.	Right kidney.				Left kidney.			
	Male.		Female.		Male.		Female.	
	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.
XI	3	16.6	0	0.0	3	16.6	1	6.2
XI and XII	1	5.5	1	6.2	6	33.3	4	13.0
XII	11	61.0	7	43.7	6	33.3	6	37.5
XII and I	1	5.5	2	12.5	2	11.1	3	18.7
I	1	5.5	5	31.2	0	0.0	2	12.5
I and II	0	0.0	1	6.2	1	5.5	0	0.0
II	1	5.5	0	0.0	0	0.0	0	0.0

POSITION OF THE LOWER POLE.

Vertebral level.	Right kidney.				Left kidney.			
	Male.		Female.		Male.		Female.	
	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.
II	1	5.5	1	6.2	1	5.5	1	6.2
II and III	0	0.0	0	0.0	4	22.2	1	6.2
III	9	50.0	7	43.7	9	50.0	8	50.0
III and IV	4	22.2	5	31.2	2	11.1	2	12.5
IV	1	5.5	1	6.2	2	11.1	2	12.5
IV and V	2	11.1	0	0.0	0	0.0	2	12.5
V	1	5.5	2	12.5	0	0.0	0	0.0

In 61 per cent of the male cases I found the right upper pole at the level of the twelfth dorsal vertebra, and in 33.3 per cent the left upper pole was either at the level of the twelfth thoracic vertebra or at the disk just above it. In both sides the next frequent levels were higher.

In 43.7 per cent of the female cases the right upper pole was found at the level of the twelfth dorsal vertebra, and in 37.5 per cent the left; in the other cases they were below these points.

It will be seen, therefore, that the upper poles in the two sides reached a higher level in males than in females by half of one vertebra.

LOWER POLES OF THE KIDNEYS

The right renal pole in males was found in varying levels from the middle of the fifth lumbar vertebra to the middle

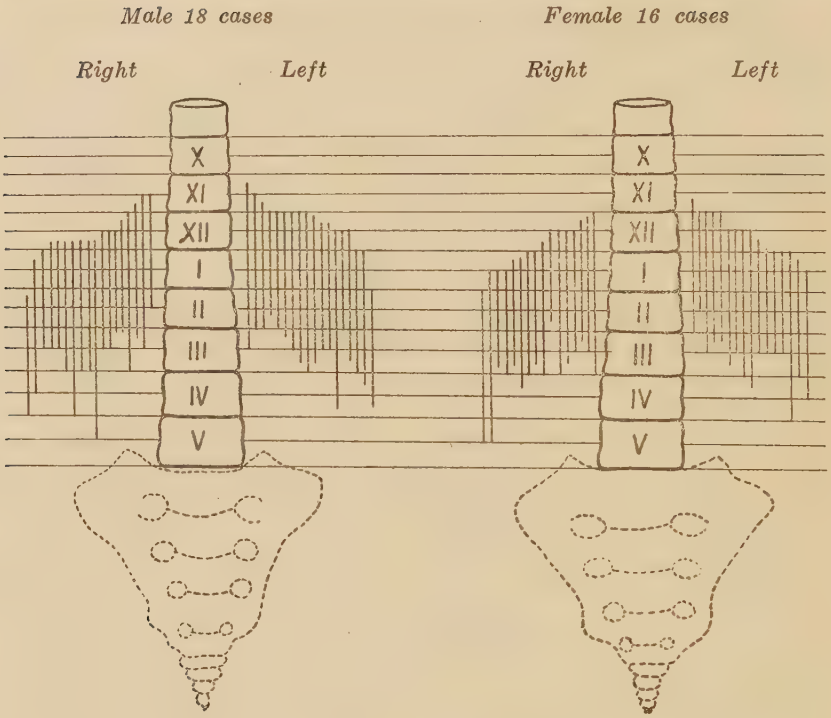

FIG. 1. Varying positions of the kidneys in the two sexes in Filipinos; thirty-four cases.

of the second, while in females it was between the middle of the fifth and the lower third of the second lumbar.

The highest level, therefore, reached in males was higher than in females by one-third of one vertebra, but the lowest level was the same in both sexes.

The left lower pole in males was between the lower third of the fourth lumbar vertebra and the lower third of the second; in females, between the disk of the fourth and fifth lumbar vertebræ and the middle of the second. The highest female level was one-third of one vertebra higher than that of the males, while the lowest female level was lower than that of the males by the same extent.

In terms of percentage, I found that the lower pole was at the level of the second lumbar vertebra in 50 per cent of the males, and in 43.7 to 50 per cent of the females, the tendency being downward in females and in the right side of males, and upward in the left side of the males.

Piersol(3) states that the kidneys ordinarily are found opposite the twelfth dorsal and the upper two lumbar vertebræ;

I found them opposite the twelfth and extending to the body of the third lumbar. This agrees with Addison's(1) findings. I agree with Piersol's(3) statement that the axial level of the two organs is subject to considerable variation, differing even in the two sides of the same individual.

All authors consulted claimed that the right kidney was lower than the left in both sexes. This I have been able to confirm in 79.4 per cent of my cases, though 11.7 showed reversed conditions.

I further found that the male kidneys were correspondingly higher than the female, although in a few cases the lowest level in the female right lower pole was the same as in that of the male.

As to measurements of the borders of the kidneys with relation to the mid-dorsal line, I am sorry to be able to record data from only six cases; my results are tabulated below.

TABLE 2.—*Distances of renal borders to mid-dorsal line of abdomen.*

MEDIAL SUPERIOR BORDER FROM MID-DORSAL.

No.	Male.		Female.	
	Right.	Left.	Right.	Left.
	cm.	*cm.*	*cm.*	*cm.*
1	4.0	3.5	2.8	2.0
2	3.0	3.2	3.0	2.5
3	3.0	2.0		
4	3.3	3.3		
Average	3.3	3.0	2.9	2.2

LATERAL INFERIOR BORDER FROM MID-DORSAL.

No.	Male.		Female.	
	Right.	Left.	Right.	Left.
	cm.	*cm.*	*cm.*	*cm.*
1	8.2	8.5	7.2	6.2
2	8.5	8.5	9.3	8.1
3	10.0	9.3		
Average	8.9	8.8	8.2	7.1

We can deduce two general conclusions from the above table:

1. That, regardless of sex, the right kidney is found further from the median plane than the left.

2. That, in corresponding sides, it is found further from the median line in males than in females.

Such findings are in accord with those of Cunningham,(2) and others.

DIMENSIONS OF THE KIDNEYS

I have records of forty-eight cases, twenty-four males and twenty-four females. My results are shown in Table 3 and figs. 2 and 3.

TABLE 3.—*Dimensions of the kidneys at different ages in the two sexes.*

[Dimensions are given in centimeters.]

MALE.

Age.	Cases.	Right.			Left.		
		Length.	Width.	Thickness.	Length.	Width.	Thickness.
Years.							
20 to 30	6	9.75	6.07	3.92	10.13	5.96	4.10
30 to 40	9	9.88	5.50	3.50	10.87	5.74	3.30
40 to 50	3	9.36	5.90	3.50	9.56	4.95	3.50
50 to 60	3	9.23	4.90	3.50	9.60	4.50	3.50
60 to 70							
70 to 80	2	8.50	4.6	4.50	10.25	5.15	4.40
80 and over	1	8.00	5.00	2.00	8.00	4.20	3.00
General average	24	7.82	4.56	2.99	8.34	4.36	3.11

FEMALE.

Age.	Cases.	Right.			Left.		
		Length.	Width.	Thickness.	Length.	Width.	Thickness.
Years.							
20 to 30	5	10.12	5.26	4.30	10.50	5.14	4.42
30 to 40	1	9.80	4.50	3.40	10.20	4.80	3.30
40 to 50	4	9.40	5.20	3.10	10.05	4.67	3.00
50 to 60	2	10.00	5.00	4.20	9.00	6.50	4.50
60 to 70	2	8.65	4.25	3.05	8.70	4.50	2.95
70 to 80	3	7.63	4.43	3.60	7.70	4.80	3.45
80 and over	7	8.50	4.45	3.50	9.05	4.71	3.00
General average	24	9.16	4.73	3.59	9.31	5.02	3.52

MALE AND FEMALE.

Age.	Cases.	Right.			Left.		
		Length.	Width.	Thickness.	Length.	Width.	Thickness.
Years.							
20 to 30	11	9.93	5.64	4.11	10.32	5.55	4.26
30 to 40	10	9.84	5.00	3.45	10.80	5.10	3.30
40 to 50	7	9.38	5.57	3.30	9.80	4.81	3.20
50 to 60	5	9.76	4.93	3.85	9.30	5.50	4.00
60 to 70	2	8.65	4.25	3.05	8.70	4.50	2.95
70 to 80	5	8.06	4.51	4.05	8.97	4.97	3.92
80 and over	8	8.25	4.72	2.75	8.52	4.45	3.00
General average	48	9.12	4.95	3.47	9.49	4.98	3.66

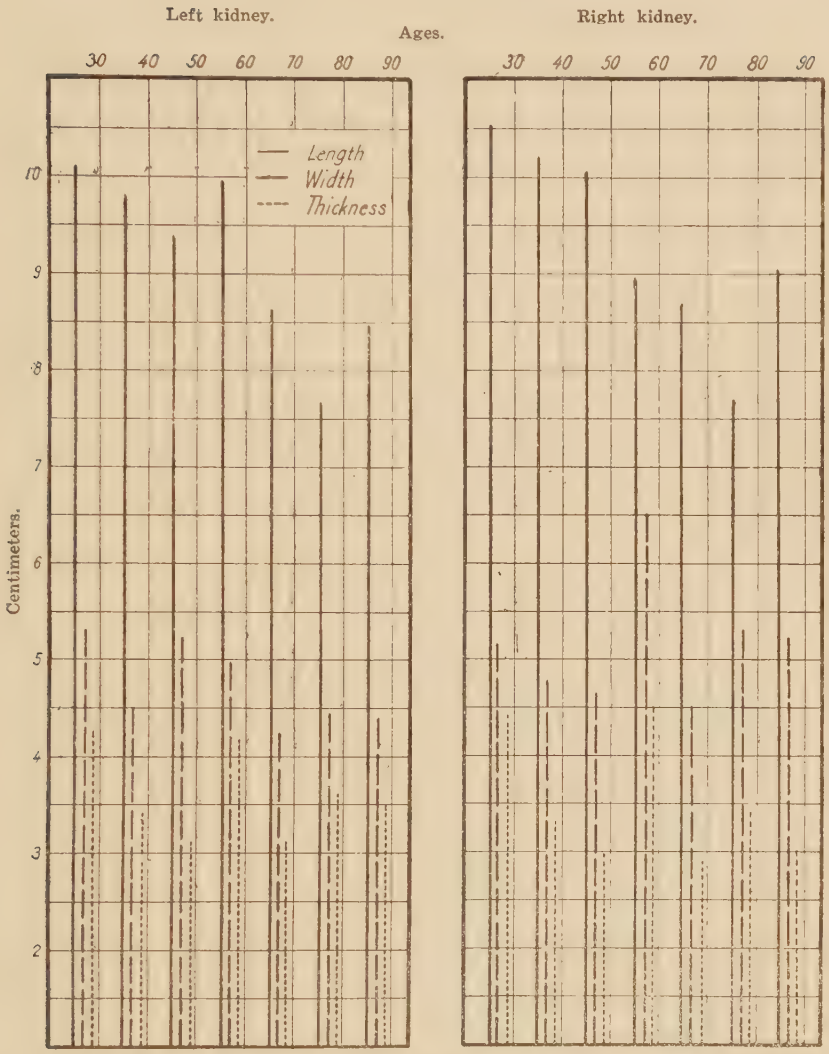

FIG. 2. Dimensions of the kidneys of females in relation to age.

From the above we find that in general the left kidney is larger than the right, exceeding it by 0.37 centimeter in length, 0.03 centimeter in width, and 0.19 centimeter in thickness. Piersol(3) bears out my findings with reference to the larger size of the left kidney.

The female kidneys were decidedly larger than those of the males, taken in general or by corresponding sides.

In relation to different ages, I found a gradual increase in size, which in males attained its maximum at the age of 30 to 40 years, a gradual decline being noted with advancing age.

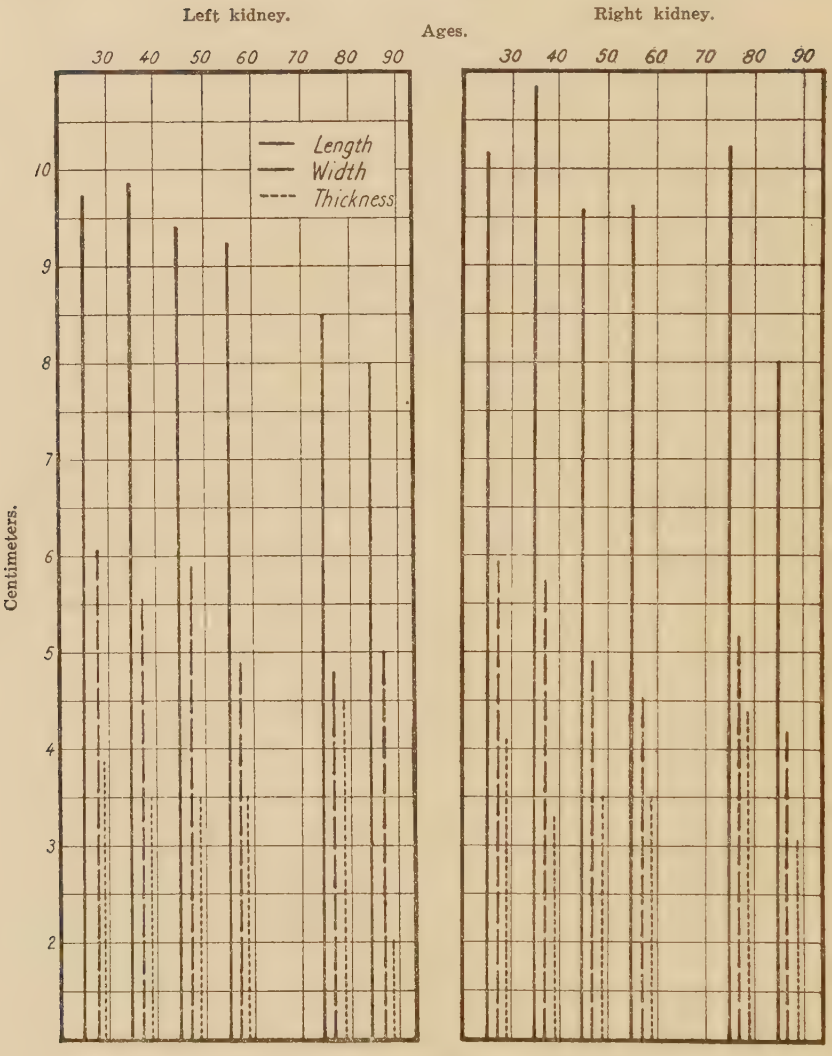

FIG. 3. Dimensions of the kidneys of males in relation to age.

In females there is also an increase in size up to the age of 30 and a very slow diminution up to the age of 80, with a secondary increase beyond that time.

SUMMARY

Briefly, my findings may be summarized as follows:

1. The kidneys were in general at higher levels in males than in females.

2. The variability of the horizontal planes of both kidneys was greater in males than in females.

3. The upper pole of both male kidneys was generally found at the lower half of the twelfth dorsal vertebra, and in the case of the left often at the level of the disk above it, with a tendency in both sides to be higher. In females it is also found at the level of the twelfth dorsal vertebra, though apparently not so frequently as in males, with a tendency to occupy lower levels.

4. The right kidney is found farther from the median line of the back than the left, regardless of sex, and in corresponding sides it is found farther from that point in males than in females.

5. In general the left kidney is larger than the right.

6. The female kidneys, considered either in general or by corresponding sides, were larger than those in the males.

7. There is a gradual increase in size of both kidneys with age, up to a certain maximum, attained in males between 30 and 40 years, and in females up to the age of 30 with a gradual decline thereafter.

I wish to thank Dr. Arturo Garcia for helpful suggestions in the preparation of this paper.

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ILLUSTRATIONS

FIG. 1. Diagram showing vertebral levels of kidneys in the two sexes.
2. Chart showing dimensions of kidneys in females.
3. Chart showing dimensions of kidneys in males.

LENGTH AND POSITION OF THE VERMIFORM APPENDIX IN FILIPINOS [1]

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ONE TEXT FIGURE

The present paper covers a short preliminary anatomical survey of the vermiform appendix in Filipinos and is intended to be followed by a more comprehensive study. While the work may be devoid of clinical interest and importance, yet it is felt that, from the anatomical point of view at least, it may initiate a series of investigations on the anatomy of the other organs which may establish some fixed Filipino standards.

We are here considering only the length and the position of the appendix. Our series includes some three hundred forty cases, the majority of which were autopsied in the department of pathology, which naturally limited the scope of our work. Some of our measurements were taken by Dr. Juan C. Nañagas, of the department of anatomy, and in a few cases by ourselves. In the latter instances, we have invariably measured the appendix in situ, following uniformly the same technic in every case. The position of the appendix was first studied while in the body, and, after dissecting away the mesoappendix, we measured the organ stretched in a straight line on a flat surface.

The distribution of our cases is as follows:

TABLE 1.—*Distribution of the cases.*

Age.	Females.	Males.	Total.
CHILDREN.			
Stillbirths	85	54	
Under 1 year	84	26	
Between 1 and 14 years	26	11	236
ADULTS.			
Between 14 and 20 years	12	9	
Between 20 and 30 years	19	12	
Between 30 and 40 years	13	9	
Between 40 and 50 years	11	1	
Between 50 and 60 years	3	3	
Between 60 and 70 years	6	2	
Between 70 and 80 years	1	3	104

[1] Read before the Manila Medical Society, October 4, 1920.

LENGTH OF THE APPENDIX

Notwithstanding the fact that Berry,(1) in his detailed survey of one hundred cases, claimed that the length of the vermiform appendix is not so variable nor so long as textbooks would lead one to believe, yet the review of the literature on the subject has convinced us that the range of variation of this measurement is indeed great. Tables 2 and 3 give an idea of such variation:

TABLE 2.—*Showing extremes and combined general average in length of appendix.*

Authors.	Cases.	Extremes of length.	Combined average.
		cm.	*cm.*
Piersol(21)		1.0–24	8.4
Jackson and Morris(12)		2.0–25	8.0–10.0
Fawcett and Blachford(6)	350	1.5–19	8.44
Berry(1)	100	3.1–13.3	8.3

TABLE 3.—*Showing combined general average length of appendix in children and adults.*

Authors.	Cases.	Combined average in—	
		Adults.	Children.
		cm.	*cm.*
Valentin(35)		[a]	4
Couveilhier(4)		3–16	
Krause(15)		5.4–8.1	
Luschka(18)		5–8	
Tarenetzki(32)		[b] 8.6	6.6
Tarenetzki(32)		[c] 6.6	
Nowicki(20)	420	7.4	
Fillimoski(8)	100	6–8	
Clado(3)		8	
Ribbert(23)	400	8.3	
Berry(1)	100	8.3	
Fawcett and Blachford(6)	350	8.4	
Sprengel(29)	98	8.5	
Sudsuki(30)	500	8.6	
Kelynack(14)		9.0	
Struthers(31)		9.0	
Bryant(2)		9.0	
Smith(27)		9.0	
Fowler(10)		9.0	
Ransohoff(22)		10.2	
Treves(33)		10.2	
Ferguson(7)		11.4	

[a] Newly born. [b] Adults up to 49 years. [c] Adults up to 83 years.

Our three hundred forty cases showed extremes of length to be 2 centimeters and 20, the combined average being 8.5.

Regarding the general average of the appendicial length, we found that different authors obtained different results. We give below another table setting forth these facts:

In our three hundred forty cases the combined average length in adults was 8.5 centimeters.

From Table 3 we can deduce that the average length, as measured by different authors, is a variable factor. We might perhaps account for this variability by differences in technic and the probable fact that the point of commencement of the appendix is not uniformly determined by the different investigators. Following the procedure of Berry,(1) averaging the different general averages in order to minimize the coefficient of error, we have found the combined average of all to be from 7.7 to 8.6 centimeters.

The shortest appendix on record is reported by Fawcett and Blachford,(6) to be 1.5 centimeters. Unusually long appendices were reported up to the present as follows:

	cm.
Sonneberg(28)	25
Lafarelle(16)	23
Luschka(18)	23
Ribbert(23)	21

In our series, the shortest was 2 centimeters and the longest 20.

Textbooks as a rule state the average length of the appendix without any reference to age or sex relation. Berry and Nowicki claimed to have obtained definite variations in these relations. On the other hand, Fawcett and Blachford(6) conclude that, while there may be a definite relation between the length and the sex, the relation to age is not very conclusive. Tables 4 and 5 illustrate these points.

While no sweeping conclusion can be drawn from these tables, yet we agree with Nowicki(20) that there is a gradual, steady growth in the length of the appendix up to a certain age, which in his cases happened to be between 20 and 40 years (in ours between 20 and 50), from which time a gradual decline is noted until, at the age of 80 or over, he found the difference or loss to be about 1 inch, while our combined average was 4.4 centimeters less than our longest average.

The general statement frequently made that the appendix is longer in the young than in the aged appears to find confirmation in our findings as well as in those of the authors quoted in tables 4 and 5.

TABLE 4.—*Relation of length of appendix to age.*

Age.	Fawcett and Blachford. (6)		Nowicki. (20)		Berry. (1)		Our cases.	
	Cases.	Average length.	Cases.	Average length.	Cases.	Average length.	Cases.	Average length.
		cm.		*cm.*		*cm.*		*cm.*
Birth to 10 years	------	------	------	5.2	18	7.4	229	4.2
10 to 20 years	9	8.0	------	7.2	1	11.5	29	8.1
20 to 30 years	31	7.7	------	8.4	8	8.8	31	8.6
30 to 40 years	65	9.06	------	8.8	19	8.9	22	8.6
40 to 50 years	66	8.5	------	8.7	15	8.3	12	9.6
50 to 60 years	59	8.66	------	8.0	18	8.3	6	8.0
60 to 70 years	58	8.62	------	7.7	5	8.0	8	8.2
70 to 80 years	49	7.48	------	6.9	6	7.6	3	5.2
80 to 90 years	10	8.8	------	6.3	------	------	------	------
90 to 100 years	3	7.3	------	6.0	------	------	------	------

TABLE 5.—*Showing relationship of the length of appendix to age and sex.*

Age.	Fawcett and Blachford. (6)				Nowicki. (20)				Our cases.			
	Male.		Female.		Male.		Female.		Male.		Female.	
	Cases.	Average.	Cases.	Average.	Cases.	Average.	Cases.	Average.	Cases.	Average.	Cases.	Average.
		cm.		*cm.*		*cm.*		*cm.*		*cm.*		*cm.*
Stillbirths	------	------	------	------	------	3.3	------	3.0	85	3.7	54	3.6
Under 1 year [a]	------	------	------	------	------	5.0	------	5.4	34	4.1	26	4.1
1 to 10 years	------	------	------	------	------	7.0	------	7.3	21	7.0	9	6.6
10 to 20 years	5	9.2	4	6.5	------	8.8	------	8.0	17	8.1	12	7.9
20 to 30 years	13	8.92	18	6.8	------	9.5	------	8.2	19	9.3	12	7.8
30 to 40 years	43	8.95	22	9.2	------	9.5	------	8.0	13	9.4	9	7.5
40 to 50 years	40	8.96	26	7.9	------	8.6	------	7.4	11	9.6	1	9.0
50 to 60 years	32	9.1	27	8.1	------	8.4	------	7.1	3	10.1	3	6.0
60 to 70 years	30	9.4	28	7.7	------	7.7	------	6.1	6	8.4	2	7.5
70 to 80 years	24	7.8	25	7.1	------	5.5	------	6.6	1	6.0	2	4.8
80 to 90 years	8	8.4	2	10.3	------	[b]	------	------	------	------	------	------
90 to 100 years	2	7.0	1	8.0	------	6.0	------	6.0	------	------	------	------

[a] Valleé (36) as cited by Scammon (25) in an analysis of 100 cases of infants from birth to 1 year gives the length of the appendix from 2.5 to 13.0 centimeters with an average of 4.6.

[b] Over 80 years.

As to the relation between sexes the majority of the authors seem to agree that, in general, the appendix of the male is longer than that of the female.

In our cases the male appendix averaged 9.10 centimeters and the female, 7.30.

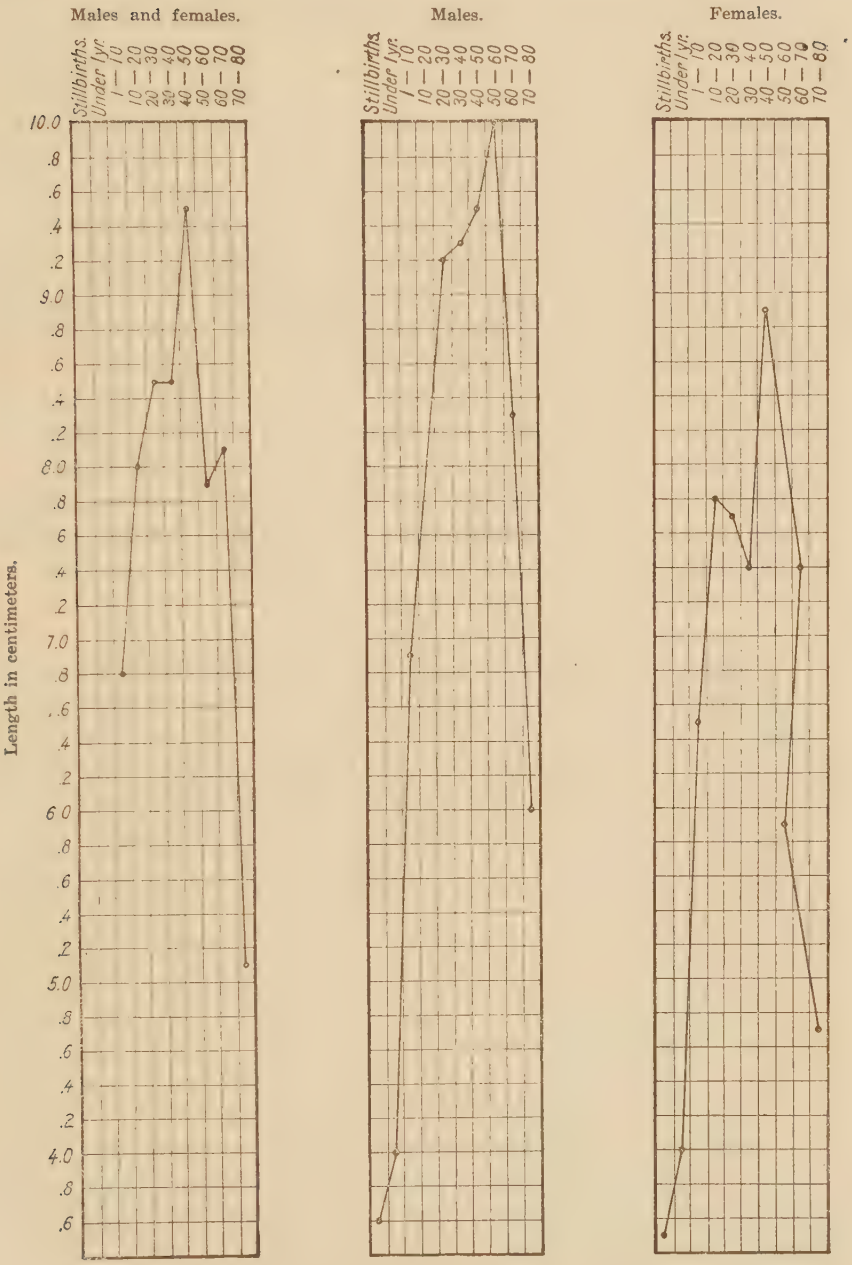

FIG. 1. Length of appendix in relation to age.

On the other hand, Finnell(9) and Kelynack(14) reverse the above findings. The former gives an excess of 1 centimeter and the latter 1.4 millimeters in favor of females. The excess found

	Male average.	Female average.
	cm.	*cm.*
Fawcett and Blachford(6)	8.88	7.87
Nowicki(20)	7.40	7.20
Berry(1)	8.60	8.00

by Kelynack(14) is so small that it may be ascribed to an error of procedure. The difference in our figures appears larger than that of other investigators, and we believe this to be due to the personal equation because, as stated in the forepart of this paper, our measurements were taken by several persons.

It is said that the length of the appendix has an important bearing upon the functional activity of the organ and that it plays a part in the etiology of appendicitis. It is certainly conceivable that a long appendix is more prone to become adherent in any pericæcal inflammatory process or hernial formation than a short one.

POSITION OF THE APPENDIX

We must realize from the start that the position of the vermiform appendix, even in normal conditions, is exceedingly variable. The absence of adhesive bands, its great mobility in the abdomen, the influence of such factors as the contents of the bowel, the pelvis, and various other conditions which affect its topography make the task of defining the position of the appendix a very difficult and uncertain proposition.

Robinson(24) says that the position of the appendix is greatly influenced by the following factors:

Length of the mesoappendix.
Degree of fullness of the stomach, colon, cæcum, etc.
The size and position of the uterus.
The sex of the individual.
Pressure and rigidity of the abdominal wall.
Presence or absence of adhesions.

To the above conditions Nowicki(20) further adds the uncertainty of the point of the cæco-appendicial union. Moreover, the conditions in the abdominal cavity of the living are so different from those in the dead that Piersol(21) goes so far as to say: "The position after death is, except in certain cases, no guide to that during life."

Cunningham(5) and Berry(1) attempt to classify appendicial positions into:

The pelvic position.
The retrocæcal position.
The inward position (pointing toward spleen).
Variable.

They lay special emphasis upon the futility of assigning any percentage of frequency to any one of the positions, but believe that they occur in the order given.

Giannelli,(11) in his topographic study of the vermiform appendix in fifty cadavers, classified them as follows:

	Per cent.
Retroileal	36.3
Retroileal-mesenteric	31.5
Retrocæcal	22.7
Pelvic	9.0

Regarding direction he reports:

Retroileal and pelvic, the appendix is rectilinear.
Retroileal and retroileal-mesenteric, it either forms an ansa or a figure of 8.

Piersol(21) claims that, in the majority of cases, the appendix is wholly behind the cæcum, either below or mesial to it.

Ferguson,(7) in a record of one hundred twenty-three cases of presumably normal appendix, found the organ hanging downward in eleven cases; placed mesially in eighteen; on the right of the cæcum in nineteen; and behind it in seventy-five.

Müller(19) says that of all the various positions of the appendix, the "positive sub coecal" is the most commonly found.

Waldeyer(37) regards the pelvic position, or that in which the appendix overhangs the brim of the pelvis crossing the iliopsoas muscle and common iliac vessels, as the normal and most common position. Nowicki(20) agrees with him and claims to have found it in one hundred eighty-nine cases out of a series of four hundred twenty. He believes the downward and the lateral positions to be rare, being present in only seventeen cases of his series. In forty-five he found the appendix to be retrocæcal; in forty-eight directed upward (forty upward and medially and eight upward and laterally); in fifty-eight (forty men and eighteen women) the appendix was parallel to the ileum up to the ileocæcal junction, in which position Jawroski and Lapinski(13) believed that it was palpable in 51 per cent of the eight hundred cases which they studied.

Schoppler(26) and Liertz(17) consider the antecæcal position as very rare.

We found Turner's(34) classification of the topography of the appendix the most varied and complete in details. He gives the following types:

Appendix lies free in the abdominal cavity.

	Cases.
Hangs down in the pelvis proper	51
Lies across the psoas toward the promontorium	20
Lies free on the musculus iliacus or psoas	6
Runs parallel to the lateral surface of the colon	2
Lies in the central abdominal region, under the right part of the colon transversum	2
Lies under the sigmoid flexure in the right iliac region	1
Total	82

Appendix lies behind the initial part of the colon ascendens between this and the posterior abdominal wall or iliac wall.

	Cases.
Lies rolled up behind the ileo-cæcal junction	4
Lies behind the cæcum bent into the fossa subcæcalis	5
Runs along the posterior or the posteromedial surface of the colon upward	6
Runs the same way but completely extraperitoneal	2
Same as the next preceding but only partially extraperitoneal	4
Lies beyond the cæcum which has previously turned up and backward	?

From the above different classifications we can deduce that the range of positions in which the adult appendix may be found is indeed great. If we further consider the pathologic immobilizations which may affect it, we can conclude that to set a definite position for the appendix is next to impossible. There are even cases in which the topographic variability of the appendix has gone beyond the confines of the abdominal cavity, when it was found included either in inguinal, or femoral, or other types of hernial protrusions.

It seems, however, the consensus of opinion that, among the more frequent positions, the "pelvic type" is the most commonly encountered and the "antecæcal" the most rare. In children, especially in those of tender age, the difficulties of classifying positions become more apparent for the reason that we must consider, in addition, the mobility and the descent of the cæcum.

In studying the position of the appendix we were able to find topographic records of thirty-five adult cases and of

seventy-five children. Seventeen per cent of the adults showed adhesions; in children, with the exception of two cases, the appendix was lying free in the abdominal cavity.

Following Turner(34) we divided the positions encountered into:

Appendix found behind the cæcum, behind the colon, or behind the ileum.
- Retrocæcal, where the appendix is behind the cæcum coiled upon itself, or crossing toward the median line or laterally, or lodged in the subcæcal fossa.
- Retrocolic where the appendix is lying behind the ileum running upwards either along the posteromedial or posterolateral border of the colon.
- Retroileal, where the appendix is behind the ileocæcal junction curled upon itself or winding around the ileum.

Appendix found below the cæcum.
- Subcæcal, where the appendix is found below the cæcum in the fossa iliaca dextra crossing the iliopsoas muscle either toward the promontory or turning laterally toward the iliac spine, or simply coiled on itself and pointing downward.
- Pelvic, where the appendix is found overhanging the brim of the true pelvis.
- Antecæcal, appendix found in front of the cæcum.
- Anteileal, appendix found in front of the ileocæcal junction.

We found adult cases distributed as follows:

Retrocæcal, 28 cases (21 males, 7 females), or 80 per cent.
Retroileal, 3 cases (2 males, 1 female), or 8.5 per cent.
Subcæcal, 2 cases (males), or 5.7 per cent.
Anteileal, 1 case (male), or 2.8 per cent.

The cases of children were distributed as follows:

Subcæcal, 31 cases (21 males, 10 females), or 41.3 per cent.
Retrocæcal, 15 cases (12 males, 3 females), or 20 per cent.
Retrocolic, 15 cases (10 males, 5 females), or 20 per cent.
Retroileal, 12 cases (7 males, 5 females), or 16 per cent.
Antecæcal or anteileal, 2 cases (1 male, 1 female), or 2.6 per cent.

Our results in adults seem to agree with those of Giannelli(11) in that the retrocæcal and retroileal positions were most frequent, differing, however, in that we found the retrocæcal position the commonest, while in his series the retroileal was most frequently encountered. Piersol(21) and Ferguson(7) also reported similar findings; but others, among them Waldeyer,(37) Nowicki,(20) Turner,(34) Cunningham,(5) and Berry,(1) have made the statement that the "pelvic position" was the most frequently encountered and some of them have even gone so far as to claim that this position was "normal." We have not found it in a single case.

We can confirm the statement that "antecæcal positions" are infrequent. We met it in only 2.8 per cent of our adults and in 2.6 per cent of the children.

The appendix in the children was situated higher in the right lumbar region, in front of the kidney and just below the liver. The subcæcal position was the common position encountered, and the retro positions came next. The pelvic position was not seen. These facts are to be expected because of the progressive descent of the cæcum and the appendix in childhood.

While it is rather difficult to draw very definite conclusions from the above work, due to its rather incomplete nature, yet we can safely deduce the following salient facts:

1. That the length of the human appendix is very variable and does not seem to keep any definite relation to race.

2. That in Filipinos the length of the appendix bears a definite relation to age, being relatively longer in younger than in older persons and, furthermore, that it gradually grows in length with age, attaining its maximum between the ages of 20 and 50 years, gradually declining thereafter.

3. That it is longer in males than in females.

4. That it is higher in children than in adults and that in the former the subcæcal is the commonest position and the retrocæcal in the latter, the antecæcal being very rare in either.

5. That the pelvic position considered normal by some authors was not even found in this series and must be considered infrequent in Filipinos.

Our thanks are due to Prof. H. Windsor Wade, of the department of pathology and bacteriology, for courtesies extended in turning over to us the records of autopsies of his department, and to Dr. Juan C. Nañagas for permitting us to include in this work his measurements of the appendix.

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ILLUSTRATION

TEXT FIGURE

FIG. 1. Length of appendix in relation to age.

PHILIPPINE AND BORNEAN SPECIES OF HOPLIONOTA (COLEOPTERA)[1]

By Frank Spaeth

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Through the kindness of Dr. L. O. Howard of the Bureau of Entomology, United States Department of Agriculture, I have received two small collections containing Cassididæ, collected during recent years in the Philippines, Singapore, Penang, and Borneo by Prof. Charles F. Baker. Among the specimens I found the new species of *Hoplionota* described in this paper, which bring the number of species of this interesting genus, that are known from the Philippines, up to fifteen, of which nine have been discovered by Professor Baker.

Hoplionota dapitana sp. nov.

Oblong-quadrata, parum convexa, nitida, rufotestacea, discis prothoracis elytrorumque laete ferrugineis, elytris biseriatim nigro-tuberculatis; antennae breves clava valde incrassata; crista frontalis oculos sat superans, apice dilatata et subtruncata; prothorax brevis, transversus, disco laevi, transversim biimpresso ibique punctato, lateribus profunde, crebre punctatis; elytra prothorace parum latiora, lateribus subparallelis, disco punctatostriato sinecarinis; protectum deplanatum, sat crebre punctatum; femora antica sat incrassata; 5.5 x 4.25 mm.

Mindanao, Dapitan (*Baker*).

Rechteckig, nicht ganz doppelt so lang als breit, schwach gewölbt, glänzend, unten gelb, oben rötlich-gelb, die Scheiben des Halsschildes und der Flügeldecken hell rostrot, welche Färbung hinter der Seitendachbrücke auf den inneren Teil des Seitendaches verbleichend ausläuft; die Flügeldecken mit schwarzen Höckern.

Kopfschild rechteckig, doppelt so lang als breit, mit lanzettförmigem, grubig ausgehöhltem Mittelstück; die Stirnlinien schwach gebogen, an der Fühlerwurzel zusammenstossend, hier

[1] In the present paper the critical notes following the descriptions are published in German as written by the author. The title and introduction have been translated into English.—Editors.

vom Augenrand weit entfernt; die Kopfplatte vor die Augen weit vorgezogen und hier erweitert, an der Spitze abgestutzt, mit einer kaum merklichen Ausrandung und verwachsener Naht. Fühler hell rötlich, kurz, die Halsschildseiten nicht erreichend, mit 4-gliederiger, stark verdickter Keule; das fünfte und siebente Glied länger als die anderen, das neunte und zehnte mehr als doppelt so dick als lang.

Halsschild kurz, mehr als doppelt so breit als lang, mit trapezförmigem Ausschnitt; die Basis ausserhalb der Basalzähnchen schwach vorgezogen, die Hinterecken stumpf gerundet, fast schon in der Längsmitte, die Seiten nach vorne sehr schräg, schwach gebogen, gesägt; die Scheibe bis auf die punktierten zwei Quereindrücke glatt, die Seiten des Vordaches mit sehr groben, ziemlich dichten Punkten.

Flügeldecken wenig breiter als der Halsschild, an der Basis abgestutzt, die Seiten bis vor die Mitte sehr schwach erweitert, dann fast parallel; die Scheibe sehr flach gewölbt mit bis zum Abfall sehr schwach ansteigender, gerader, dann in schnellem Bogen abfallender Profillinie; die Punkte in regelmässigen, aber wenig heraustretenden Streifen, wobei Zwischenräume und Abstände nicht breiter sind als die Punkte; Rippen fehlen; die isolierten Höcker sind schwarz, stark glänzend und zuweilen in der Dorsalreihe vier, davon der Haupthöcker schmal, messerförmig, länger, kaum höher als die anderen, in der Humeralreihe fünf, hievon die vier vorderen strichelförmig mehr minder quergestellt, der letzte Knopfförmig, klein; der vorderste geht von der Basis auf die Schulterbeule, der zweite ist länger, schwach S-förmig, der dritte an der Seitendachbrücke, ein Rest der Pontalleiste, länger als die anderen, S-förmig, reicht schräg nach hinten gerichtet bis über die Mitte in die Scheibe hinein. Seitendach breit, flach ausgebreitet, nicht geneigt, gröber als die Scheibe, wie das Vordach punktiert, am Rande mit einem Saume sehr dicht gereihter, kleinerer Punkte. Die Schenkel sind besonders an den Vorderbeinen verdickt.

Unter den bisher von den Philippinen beschriebenen Arten hat nur die mir unbekannte *H. granulosa* Weise [2] von Palawan eine ähnliche Skulptur der Flügeldecken; sie ist aber gerundet und ganz anders gefärbt; auch die von den Sunda-Inseln bekannten *Hoplionoten* ohne Rippen haben durchwegs gerundeten Umriss und sind oben viel dunkler.

[2] Deutsche ent. Zeitsch. (1915) 511.

Im Vergleiche zu *taeniata*, von der sie sich natürlich schon durch die ganz andere Skulptur unterscheidet, ist sie schlanker und länger, weniger gewölbt; der Halsschild ist kürzer, an den Hinterecken mehr vorgezogen, die Seiten sind schräger, das Seitendach ist schmäler, die Fühler sind kürzer, die Keule dicker.

Für die freundliche Ueberlassung der Typen dieser und der folgenden Arten bitte ich Herrn Professor Charles F. Baker auch noch an dieser Stelle meinen Dank entgegenzunehmen.

Hoplionota hedysma sp. nov.

Quadrata, parum convexa, nitida, rufotestacea, supra flavotestacea, discis prothoracis elytrorumque saturatiorbus, luridis, tuberculo principali et apicali vittaque indeterminata longitudinali hiscoiuneta piceis; protecto pone medium vitta lata transversa ferruginea; crista frontalis oculas sat superans, apice acuminata, apice incisa, incisione basi emarginata; prothorax transversus, angulis posticis haud porrectis rectangulis, disco laevi, transversim biimpresso, ibique punctulatus, lateribus profunde, minus crebre punctatis; elytra punctatostriata, carina dorsali, pontali suturali, apicali et terminali tuberculis parvis; fusca externa, interna et costa humerali subobsoletis; protectum latum, deplanatum, minus crebre punctatum, limbatum; 6.5 x 5.5.

LUZON, Mount Banahao (*Baker*).

Eiförming, annähernd rechteckig, um die Hälfte länger als breit, an den Seiten wenig erweitert, mit der grössten Breite in der Mitte der Flügeldecken; mässig gowölbt, stark glänzend, rötlich gelb, die Scheiben des Halsschildes und der Flügeldecken gesättigt braungelb, der Haupt- und der Apikalhöcker, die Pontal-, Sutural- und Apikalleiste, sowie ein breiter, unbestimmter Längswisch aussen auf der Scheibe pechbraun, eine breite Querbinde hinter der Mitte des Seitendaches rostrot.

Kopfschild mehr als doppelt so lang als breit, mit lanzettförmigem, an der Basis gegabelten, undeutlich längsgekieltem Mitteleindruck. Kopfplatte vor die Augen mässig vorgezogen, zugespitzt, mit einem tiefen, innen erweitertem Einschnitt. Fühler bei dem einzigen, übersendeten Stücke stark beschädigt. Halsschild quer, mehr als doppelt so breit als lang, an der Basis aussen wenig vorgezogen, mit scharf rechtwinkligen Hinterecken und zu Anfang fast parallelen, dann stark gerundeten Seiten; die glatte Scheibe hat zwei Quereindrücke, deren vorderer schmäler, feiner punktiert und in der Mitte unterbrochen ist;

die Punkte auf dem Vordache sind grob, mässig dicht. Die Flügeldecken sind an der Basis kaum breiter als der Halsschild, haben rechtwinklige Schulterecken und schwach gerundete Seiten; die Punktstreifen auf der Scheibe sind grob, fast regelmässig; der Dorsalkiel ist nirgends unterbrochen, aber vor und nach dem Postbasalhöcker sehr schwach; seine vier Höcker sind in die Länge gezogen, niedrig, nur der Haupthöcker höher, stumpf, vierkielig; der Humeralkiel ist vorne erloschen, vor der Pontalleiste sehr schwach, geradlinig; die Pontalleiste setzt als Suturalleiste bis nahe an die Naht fort; ebenso beginnt die Apikalleiste noch innerhalb des Apikalhöckers, sendet von der Marginalhöckerstelle, die nicht höher ist als die umgehenden Kiele, die costa ultima, dann die costa terminalis zum Seitendache, während furca interna und externa nur rudimentar sind. Das Seitendach ist flach ausgebreitet, breit, auch hinten nur wenig verschmälert, ziemlich zerstreut und nur mässig grob (feiner als das Vordach des Halsschildes) punktiert, auf der rostroten Querbinde quergefaltelt, aussen mit einer schwach erhabenen, durch eine nicht dichte Punktreihe abgesetzten Randleiste.

Hoplionota hedysma ist in Grösse und Körperform der *H. modesta* Wag. und *sexnotata* Weise ähnlich, hat mit der ersteren die Bilding des Kopfschildes, mit der letzteren die des Halsschildes gemeinsam; von *modesta* ist sie durch andere Färbung und Zeichnung, nach vorne weniger rasch verengte Seiten des Seitendaches, weniger entwickelten Basal- und Postbasalhöcker, nicht so stark einwärts gestellten Apikalhöcker, den Ansatz der furca interna, von *sexnotata,* abgesehen von der ganz anderen Zeichnung, dadurch verschieden dass bei der letzteren Apikalkiel und Apikalhöcker vollständig fehlen und nur eine isolierte Gabel, bestehend aus Ansätzen der furca interna und externa mit einem gemeinsamen Stiele, übrig geblieben ist.

Hoplionota benguetina sp. nov.

Obquadrangularis, parum convexa, nitida, flavotestacea, supra fuscobrunnea, prothorace apice utrinque protecto que albidoflavis, hoc ramis duobus latis piceofuscis; antennae minus breves, clava crassa; crista frontalis oculos valde superans, antice rotundata, dentibus duobus minimis instructa; prothorax brevis, transversus lateribus oblique rotundatis, disco laevi transversim biimpresso; ibique punctato, lateribus profunde punctatis; elytra prothorace parum latiora, moxpone humeras breviter ampliata ibique latissima, tum oblique angustata, apice subtruncata, disco

striatopunctato, carina dorsali, pontali, suturali, apicali et humerali, hac basi obsoleta, tum furca interna et externa abbreviatis, tuberculis parvis, principali parum altiore; protectum sat latum in macula albida media sublaeve; 4.7 x 4.2 mm.

LUZON, Benguet, Baguio (*Baker*).

Verkehrt-trapezförmig mit der grössten Breite bald hinter den Schultern, von hier nach vorne schnell, nach hinten schwach und allmälig, fast geradlinig verengt, am Ende fast abgestutzt; mässig gewölbt, glänzend; gelb, Kopf und Fuhler rötlichgelb, oben hell pechbraun, auf dem Vordache und dem Seitendache dunkler; der Umkreis der Vorderecken des Halsschildes und der Basalsaum zunächst den Basalzähnchen weisslichgelb; auf den Flügeldecken eine Makel aussen vor den Schulterbeulen und die Dorsalrippe in der Vertiefung zwischen Haupt- und Apikalhöcker gelblichrot, das Seitendach weissgelb mit je zwei dunkleren Randästen als die Scheibe.

Kopfschild schmal, um die Hälfte länger als breit, mit lanzettförmigem, durch konvergierende Stirnlinien begrenzten Mittelstück. Die Fühler überragen wenig die Halsschildecken, ihre Basalglieder sind ziemlich gestreckt, einschliesslich des siebenten Gliedes glänzend; die vier Endglieder bilden eine stark verdickte, dicht behaarte Keule, deren innere Glieder (neunte und zehnte) doppelt so breit als lang sind. Halsschild quer, doppelt so breit als lang, an den Seiten viel kürzer als in der Mitte, die Basis ausserhalb der Basalzähnchen vorgezogen, die Ecken daher in einer fast die Längsmitte schneidenden Querlinie, rechtwinklig, die Seiten vor ihnen in sehr schwachem Bogen schräg zu den Vorderecken gerundet, die Scheibe bis auf zwei Quereindrücke, von denen der vordere fein, der rückwärtige grob punktiert ist, glatt, das Vordach mit den gewöhnlichen, tiefen Grubenpunkten.

Auf den Flügeldecken verläuft der Dorsalkiel von der Basis bis zur Spitze ohne Unterbrechung; von seinen vier Höckern ist der Postbasal sehr klein, der Basal und Apikal sind niedrig, stumpf, in die Länge gezogen, der Haupthöcker ist nur wenig höher, so hoch wie bei *rufa* Wag., vierkielig; der Humeralkiel fehlt hinter der Basis, ist anfangs bogenförmig nach innen gezogen, sehr niedrig, und erlischt am Pontalkiel; dieser quer, nicht nach hinten gezogen, steigt zum Haupthöcker an und setzt sich als Sutural bis zur Naht fort; der Apikalkiel beginnt innen vom Dorsalkiel, ohne jedoch die Naht zu erreichen, bildet einen sehr kleinen Apikalhöcker und hat kurze Ansätze der costa terminalis, furca externa und interna. Die Punktstreifen der Scheibe

sind mässig grob, kaum deutlich gereiht. Das Seitendach ist flach, wenig breit, innen an der Seitendachbrücke auf der hellen durchscheinenden Makel glatt, vorne und am Rande punktiert, hinten innen quergefaltet mit zwei Punkten in jeder Falte.

Hoplionota benguetina steht am nächsten der indischen *lenta* m., der sie auch in der Zeichnung ähnlich ist; aber bei dieser ist die grösste Breite viel weiter rückwärts, hinter der Mitte der Flügeldecken, sie ist nach vorne mehr als nach hinten verengt, an den Seiten mehr gerundet, am Ende viel breiter verrundet als vorne, während bei *benguetina* der umgekehrte Fall vorliegt; bei *lenta* ist ferner der Dorsalkiel zwischen dem ersten und zweiten Höcker unterbrochen, die Punktierung der Flügeldecken ist feiner und dichter, die furca externa fehlt, die furca interna und costa terminalis sind schwächer, der Humeralkiel ist nicht gebogen; übrigens ist auch die Oberseite weniger glänzend, die Brust schwarz, die Fühlerkeule dunkel.

Hoplionota modesta Wagener.

Durch die Erwerbung der Typen von *H. modesta, vittata, undulata,* und *biramosa* Wagener konnte ich mir über diese, mir zur Zeit der Verfassung meiner "Studien über die Gattung Hoplionota"[3] noch unbekannten Arten von den Philippinen Klarheit verschaffen.

Hoplionota modesta ist mit der unrichtigen Vaterlandsangabe "Ostindien" beschrieben, während sie auf den Philippinen vorkommt, wo sie bisher nur auf Luzon von Herrn Professor C. F. Baker bei Los Baños und dem Mount Maquiling gefunden wurde. Ich habe dieselbe Art[4] als *H. chapuisi* beschrieben und zwar jene Form, bei der die Zeichnung aus einer pechbraunen Punktmakel am äusseren, rückwärtigen Abfall des Haupthöckers und einer braunen Querbinde an der Unterseite des Seitendaches besteht, die auf der Oberseite nur heller durchscheint. Bei der typischen *modesta* fehlt die Makel am Haupthöcker, während *nitida* Weise,[5] von Herrn Professor Baker ebenfalls auf dem Mount Maquiling gesammelt, anscheinend auf ein Stück derselben Art aufgestellt ist, bei dem auch die Binde des Seitendaches fehlt. *Hoplionota chapuisi* und *nitida* sind daher nur als Aberrationen von *modesta* zu betrachten. *H. modesta* ist an der stark zugespitzten, vorgezogenen Kopfplatte, die an der Spitze einen, hinten erweiterten Einschnitt hat, an der wachs-

[3] Verh. zool-bot. Gesellsch. Wien. (1913) 381.
[4] Op. cit. 523.
[5] Deutsche Ent. Zeitschr. (1915) 511.

gelben, auf den Scheiben nur wenig gesättigteren Färbung und an der Kielbildung leicht zu erkennen; der Suturalkiel ist stark nach vorne, der Apikalhöcker nach innen gezogen, die furca interna vollständig erloschen, während die übrigen Fortsätze des Apikalkiels, mit Ausnahme der costa ultima, rudimentar sind.

Hoplionota undulata Wagener.

Von der Insel Mindanao ohne näheren Fundort beschrieben; von Herrn Professor C. F. Baker bisher nicht eingesendet, also wahrscheinlich noch nicht aufgefunden.

Hoplionota undulata gleicht im Umriss der *H. modesta,* doch ist sie etwas grösser und verhältismässig schmäler; die Farbe ist gesättigter braungelb; die Umgebung des Basalhöckers und zwei aneinander stossende Flecke auf jeder Flügeldecke rückwärts sind pechbraun, wenig scharf; der vordere dieser Flecke reicht vom Haupthöcker und dem vorderen Abfall der Pontalleiste schräg nach hinten bis an das Seitendach, so dass der Raum zwischen der Pontalleiste, der furca interna und der Terminalleiste von ihm ausgefüllt wird; der rückwärtige wird annähernd von der Apikalleiste, dem Ende des Dorsalkiels und der costa ultima begrenzt. Die Kopfplatte ist weit vor die Augen vorgezogen, breiter als bei *modesta,* vorne weniger zugespitzt, seichter eingeschnitten. Die Punktierung der Flügeldecken ist viel gröber und dichter, die Zwischenräume und Abstände sind viel kleiner als die Punkte; die Kiele sind an den Höckerstellen so wenig überhöht dass man eigentlich, mit Ausnahme des Haupthöckers, von Höckern überhaupt nicht sprechen kann; der Dorsalkiel ist nur hinter dem Basalhöcker kurz unterbrochen; der Postbasal ist kaum angedeutet, der Haupthöcker sehr niedrig, vierkielig; die Suturalleiste ist zur Naht weniger vorgezogen als bei *modesta;* die Pontalleiste geht aussen bis zum vorletzten Zwischenraum, während sie bei *modesta* schon im viert-letzten erlischt. Der Apikalkiel, die costa ultima, terminalis, die furca externa und interna sind kräftig, jedoch erreicht die letztere nicht den Haupthöcker. Das Seitendach ist grob, etwas feiner als die Scheibe punktiert, flach, hinten wenig verschmälert, schmäler als bei *modesta.*

Hoplionota vittata Wagener.

Nach der Beschreibung des Autors ist die Art schwer zu erkennen, da zumeist nur solche Merkmale hervorgehoben werden, die mehr minder ausgeprägt sich bei allen *Hoplionoten* finden, und uberdies die Angaben über die Färbung und Zeichnung einer Richtigstellung bedürfen. Wagener nennt die Makeln auf

den Flügeldecken dunkel olivengrün, während ich von dieser Farbe bei dem aus seiner Sammlung stammenden Typus absolut nichts finden kann, sondern sie als ziemlich tief pechbraun und die Querbinde hinter der Mitte des Seitendaches als unten pechbraun, oben heller durchscheinend braun bezeichnen möchte; ferner kann man auch nicht, wie es Wagener tut, von einzelnen Flecken sprechen, da sie eine durch schmale Stellen zusammenhängende Längsbinde bilden. An der Basis der Flügeldecken beginnt diese sehr breit, indem sie vom ersten bis zum neunten Punktstreif reicht und sonach ausser dem letzten Zwischenraum nur einen schmalen Nahtsaum freilässt; quer über den Dorsalkiel hinter dem Basalhöcker hinziehend, verengt sie sich auf die Breite zwischen dem fünften und dem siebenten Punktstreif; nun folgt die zweite mit der ersten durch diesen Ast zusammenhängende Makel, die vom Postbasal bis weit über die Pontalleiste reicht, aussen vom achten Punktstreif, innen vom (gelben) Dorsalkiel begrenzt wird und die sich am Haupthöcker noch über ihn zu beiden Seiten der kurzen Suturalleiste fortsetzt; weiter wendet sich die Binde mehr nach aussen, reicht hier bis an das Seitendach und hängt mit der dunklen Seitendachbinde in deren ganzer Breite zusammen um durch einen schmalen Ast längs der äusseren Partie des Apikalkiels mit der dritten Makel (im Sinne Wageners) zusammenzuhängen, die den Raum vom inneren Teil des Apikalkiels, einschliesslich seines vorderen Absturzes bis vor die Spitze und von der costa ultima bis sur Naht einnimmt. Die Scheibe ist gelblichrot; von den Kielen zeigen diese Grundfarbe nur der Dorsalkiel vor und nach dem Haupthöcker und die furca interna; die übrige Ober- sowie die Unterseite sind heller gelb, die Fühler rötlich.

Die Kiele sind schwach, die Höcker selbst der Haupthöcker treten kaum darüber hinaus; der Dorsalkiel ist nur zwischen dem ersten und zweiten Höcker unterbrochen; der Humeralkiel ist vorne S-förmig gebogen, vor der Pontalleiste erloschen; am Apikalkiel sind die costa terminalis vollständig, die furca externa und interna in Ansätzen vorhanden; Pontal- und Apikalleiste setzen sich innen über den Dorsalkiel fort. Die Punktstreifen sind grob, regelmässig, grösser als die Zwischenraüme und Abstände.

In der Körperform steht *H. vittata* unter den asiatischen Arten ganz vereinzelt; sie ist rechteckig, fast doppelt so lang als breit, an den Seiten kaum erweitert; sie erinnert an jene mancher madagassischer Arten, zum Beispiel, *gemmata* Keug und *nigriclavis* m.; der Halsschild ist an den Seiten sehr schräg

zugerundet, wenig gebogen, daher aussen kürzer als in der Mitte; die Grubenpunkte auf den seiten des Vordaches stehen weit zerstreut, die Scheibe ist bis auf die Eindrücke glatt. Der Kopfschild hat eine tiefe Grube; die Kopfplatte ist vor die Augen mässig vorgezogen, verrundet zugespitzt und nur schwach eingeschnitten. Die Fühler sind sehr kurz, nur ihr viertes und fünftes Glied etwas gestreckt, die Keule dick, ihre inneren Glieder doppelt so breit als lang, 5.5 x 4.25 mm. (nach Wagener 5 x 4.5). Der Typus stammt von der Insel Bohol.

Hoplionota taeniata F. und **biramosa** Wagener.

In meinen Studien über die Gattung *Hoplionota*[6] habe ich die bis dahin ungedeutete *Cassida taeniata* F. auf die häufigste der auf den Philippinen vorkommenden *Hoplionota* Arten bezogen und die Beschreibung enstprechend ergänzt. Die Type von Wageners *H. biramosa* die ich seitdem erworben habe, zeigt dass sie ein Stück derselben Art zur Grundlage hat; bei demselben ist die Scheibe der Flügeldecken gesättigter braungelb, die Höcker, die Pontalleiste und die Aeste des Seitendaches sind hell pechbraun, die Seitendachmakel und die Flecken neben der Spitze treten durch ihre hellere Farbe lebhafter hervor; ein ähnliches Stück mit noch kräftigeren Färbungskontrasten und zur Spitze mehr verengt wurde von Herrn Professor C. F. Baker in Baguio, Benguet, gesammelt und mir unter *No. 6099* eingesendet. Von Mr. Whitehead wurde die gleiche Form in Nord Luzon gesammelt.

Während sonach *biramosa* Wag. mit *taeniata* F. zusammenfällt, muss ich meine seinerzeit[7] ausgesprochene Ansicht, dass auch *rufa* Wag. nur eine Unterform derselben Art ist, abändern. Das reichere Material, welches mir jetzt von *taeniata* und *rufa* vorliegt, zeigt dass hier zwei von einander verschiedene Arten vorliegen. *Hoplionata taeniata* von Luzon und Balabac ist eiförmig, stets wesentlich länger als breit, mit der grössten Breite vor der Mitte der Flügeldecken, an den Seiten fast gerade, oft nach hinten stärker verengt und dann von schwach trapezförmigem Umriss; die Höcker der Flügeldecken sind über die Kiele wenig erhöht, auch der Haupthöcker viel breiter als hoch, sehr stumpf; an der Seitendachbrücke ist stets ein glasshelle, weisslicher Fleck zwischen den dunkleren Randästen, der innen schwächer punktiert, fast glatt ist. Die Halsschildseiten fallen zu den Hinterecken schräg ab. *Hoplionota rufa* Wag. ist

[6] Verh. zool.-bot. Gesellsch. Wien (1913) 496.
[7] Op. cit. 497.

stets von breiterem, fast gerundetem Körperbau, mit der grössten Breite weiter rückwarts, in oder selbst nach der Mitte der Flügeldecken, an den Seiten mehr gerundet, hinten breiter abgerundet; die Höcker sind durchwegs höher, der Haupthöcker spitzig, so hoch als breit; die Bildung der Kiele, der Fühler und des Kopfschildes ist die gleiche; auf dem Seitendache fehlen Randäste, an der Seitendachbrücke ist ein hellerer Innenfleck nicht oder kaum erkennbar, diese Stelle nicht schwächer punktiert als der übrige Teil; die Halsschildseiten fallen rechtwinklig zur Basis ab. Die Oberseite ist einfärbig rostrot (*ferruginea* m.), zu welcher Form auch die mir gehörige Type Wageners seiner *rufa* gehört, oder die Kiele sind dunkler, gebräunt (*rufa* Wag. nach der Beschreibung). Letztere Form kenne ich ausser aus Java besonders von Bogor, wo sie von Kannegieter gesammelt wurde und woher auch ein Stück mit ganz pechschwarzen Scheiben des Halsschildes und der Flügeldecken stammt. Die einfärbige Form *ferruginea* dagegen liegt mir von Java, Sumatra, Mentawei, Malakka, Perak vor und wurde von Herrn Professor C. F. Baker auf Penang und Singapore gesammelt.

Als eine durch grösse und breiteres Seitendach ausgezeichnete Rasse der *rufa* Wag. ist *sarawacensis* m.[8] zu betrachten; dagegen ist die ebenfalls als Rasse der *taeniata* beschriebene *H. quadra* m.[9] aus Nord Borneo eine eigene Art, die sich bei sonst gleicher Skulptur der Flügeldecken von *taeniata* und *rufa* durch viel kleinere Gestalt, annähernd quadratischen Umriss, kürzere Fühlerkeule, viel dunklere Farbe der Flügeldeckenscheibe, von *taeniata* überdies durch höhere Höcker und den Mangel von Randästen, von *rufa* durch weiter vorne gelegene grösste Breite und schräg, aber fast gerade nach hinten verengte Seiten unterscheidet.

Hoplionota calligera sp. nov.

Subquadrata, parum convexa, sat nitida, fulvotestacea, disco elytrorum piceo, prothorace, scutello protecto que fuscis, hoc basi, in ponte apiceque maculis laete testaceis, duabus primis callosis; antennae sat longae, clava parum incrassata; crista frontalis oculos valde superans, antice dilatata, apice subacuminata ibique incisa, incisione basi emarginata; prothorax longitudine duplo latior, basi extus haud producta; elytra basi subtruncata, angulis humeralibus subrectis, lateribus ante medium vix dilatatis, ad

[8] Op. cit. 497.
[9] Stett, ent. Zeit. (1915) 269.

apicem parum attenuatis, disco striatopunctato, carina dorsali, humerali, pontali, suturali et apicali, costa terminali et furcis brevibus, tuberculis primo, segundo et cuarto dorsalibus parvis, principali (tertio) sat acuto, sed minus alto; protecto sat lato, deplanato transversim plicatulo et punctato, tenuiter limbato, callis laevibus, nitidioribus; 5 x 4 mm.

BORNEO, Sandakan; exemplar No. 11903 a domine professore C. F. Baker detectum et liberalissime communicatum in collectione mea asservatum est.

Nahezu quadratisch, wenig gewölbt und mässig glänzend; Unterseite, Kopf und Fühler bräunlichgelb, Halsschild und Schildchen hellbraun, das Seitendach gesättigter braun mit schmalem, hellerem Saum, die Scheibe der Flügeldecken dunkel pechbraun, der Dorsalkiel bis zum Postbasal und die Basis des sechsten Punktstreifs braungelb; auf dem Seitendache sind eine kleine Makel an der Basis innen vor der Schulterbeule und eine grössere an der Seitendachbrücke gelb, stärker glänzend und schwielig erhaben; ausserdem ist an der Spitze neben der Naht jederseits ein heller, durchscheinender, verwaschener, gelber Fleck.

Kopfschild doppelt so lang als breit, mit tiefen, vom Augenrande ziemlich entfernten, konvergierenden Stirnlinien und lanzettförmigem, vertieften, verloschen gekielten Mittelstück. Stirnplatte vor die Augen stark vorgezogen, zuerst erweitert, dann zugespitzt, an der Spitze tief eingeschnitten, der Einschnitt an seiner Basis ausgerandet. Die Fühler überragen mit dem Ende der Keule die Seiten des Halsschildes; das vierte und fünfte Glied sind gestreckt, fast dreimal so lang als dick, das sechste und siebente merklich kürzer; die viergliederige Keule ist sehr schlank, nur wenig dicker als der Schaft, ihre inneren Glieder etwas länger als dick.

Halsschild stark quer, nicht halb so lang als breit, an der Basis aussen wenig vorgezogen, mit rechtwinkligen Hinterecken, die Seiten vor diesen zuerst gerade, senkrecht zur Basis, dann stark zu den Vorderecken gerundet, ihr Rand grob gesägt, der Kopfausschnitt tief, trapezförmig; die Scheibe glatt, vorne mit einem bogenförmigen, glatten, vor der Basis mit einem dicht, runzelig punktierten, geraden Quereindruck, die Seitenflügel mit den gewöhnlichen, groben Punkten. Flügeldecken an der fast abgestutzten Basis mässig breiter als der Halsschild, mit nicht vorgezogen, rechtwinkligen Schulterecken und kaum erweiterten, vor der Mitte am breitesten, dann sehr schwach verengten Seiten; die Scheibe mit dichten, engen Punktstreifen.

Der Dorsalkiel ist vollständig, aber zwischen dem ersten und zweiten und zweiten und dritten Höcker sehr niedrig, hinter dem Haupthöcker höher; der Basal- und Postbasalhöcker sind wenig hoch, aber ziemlich spitz, der Apikalhöcker stumpfer und niedriger; der Haupthöcker ist so hoch als seine Entfernung vom Postbasal beträgt, spitzig, vierkielig; der Humeralkiel ist schwach gebogen, von der Basis bis zur Pontalleiste ausgebildet, diese quer, mit einem kurzen Suturalfortsatz; die Apikalleiste welche noch innerhalb des Dorsalkiels beginnt, ist niedrig, ebenso die costa terminalis, die furca externa und interna, welche beide abgekürzt sind. Das Seitendach ist verhältnismässig breit, flach ausgebreitet, mit groben Punkten besetzt, deren Abstände zu schwach erhabenen Querfalten zusammenfliessen; am Aussenrande ein schmaler, feiner punktierter, innen durch ein erhabenes Leistchen begrenzter Saum.

Hoplionota calligera steht in der Verwandtschaft der *H. quadra* m.[10] und der *H. weyersi* m., die beide ebenfalls auf Borneo vorkommen, am nächsten, unterscheidet sich aber durch die viel schlankere, weniger abgesetzte Fühlerkeule, breitere, verhältnismässig weniger gewölbte Gestalt, viel höheren und spitzigeren Haupthöcker, breiteres und flacheres Seitendach, endlich durch Färbung und Zeichnung.

[10] Stett. ent. Zeit. 76 (1915) 269.

REVIEWS

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